ORDNANCE

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THE MAGAZINE OF SCIENTIFIC AND INDUSTRIAL PREPAREDNESS

VOL. XXXIV, No. 175 JULY-AUGUST, 1949

FOUNDED 1920

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IN THIS ISSUE

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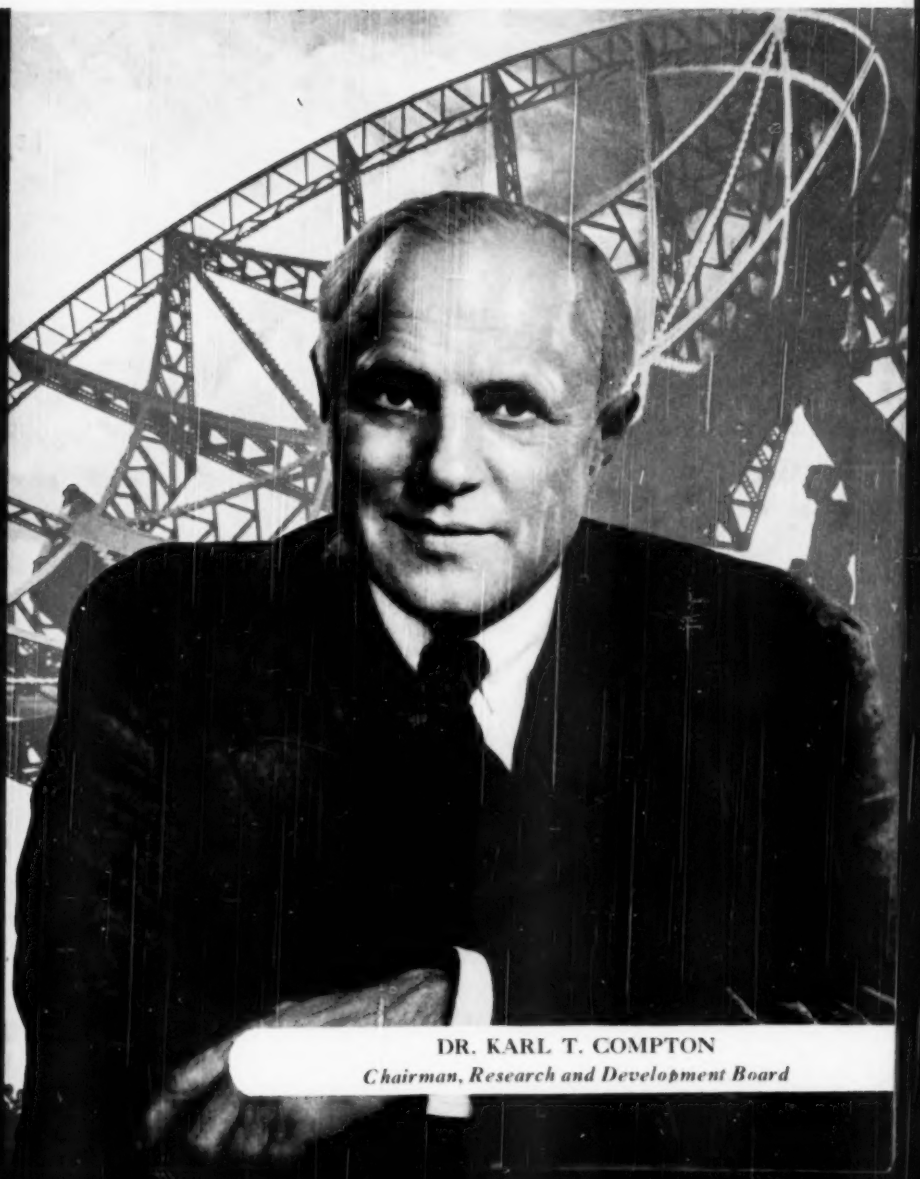
THE JOURNAL
OF THE AMERICAN
ORDNANCE
ASSOCIATION
WASHINGTON, D. C.



DR. KARL T. COMPTON
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"FORMING OF AUSTENITIC CHROMIUM-NICKEL STAINLESS STEELS"

A Detailed, Authoritative Book

This new volume of more than three hundred 8¼" by 11" pages describes in detail, modern forming techniques as applied to austenitic chromium-nickel stainless steels. Tables of engineering data and more than two hundred engineering drawings are used to supplement the text.

Contents

*

MECHANICAL PROPERTIES OF CHROMIUM-NICKEL STAINLESS STEELS

FORMING CHARACTERISTICS OF AUSTENITIC STAINLESS STEELS

PROCESSING AFTER FORMING

DESIGN, LAYOUT AND PREPARATION OF BLANKS

EQUIPMENT, TOOLS AND LUBRICANTS

BENDING AND STRAIGHT FLANGING

THE FORMING OF CURVED SECTIONS AND TUBING

FORMING OF CONTOURED-FLANGED PARTS

DEEP DRAWING OF CUP-SHAPED, BOX-SHAPED AND RELATED PARTS

DOUBLE-ACTION DIE FORMING OF DEEP- AND SHALLOW-RECESSED PARTS

FORMING OF DEEP- AND SHALLOW-RECESSED PARTS BY MISCELLANEOUS METHODS

FORMING OF SEMITUBULAR PARTS

EXPANDING AND REDUCING OF TUBULAR PARTS

Unexpected demand has exhausted the first two printings, but copies of the third printing may now be purchased through The International Nickel Company, Inc.

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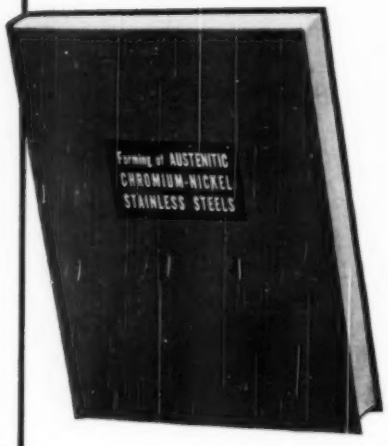

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ORDNANCE

Land • Sea • Air

Magazine of Scientific and Industrial Preparedness

THE JOURNAL OF THE AMERICAN ORDNANCE ASSOCIATION

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• This issue of ORDNANCE is devoted almost exclusively to the proceedings of the Thirty-first Annual Meeting of the American Ordnance Association held at Los Angeles, Calif., April 26 and 27, 1949. The occasion was an especially historic one: It was the first annual meeting of the A.O.A. ever to be held on the West Coast, and it was the first time that "Ordnance Day" was spent at sea witnessing tests and demonstrations of matériel aboard ships of the Navy. The officers and directors of the Association are deeply grateful to the members of the Los Angeles Post, under whose auspices the national meeting was held, for their efficient handling of local arrangements, and to the officers and men of the U. S. Navy who made the technical session such an unqualified success.

• Gen. J. Lawton Collins, Vice Chief of Staff, U. S. Army, was the principal speaker at the Thirty-first Annual Dinner, and he was ably flanked by Rear Adm. Albert G. Noble, Chief of the Bureau of Ordnance, U. S. Navy, and by Maj. Gen. Everett S. Hughes, Chief of Ordnance, U. S. Army. This high-caliber trio gave the Ordnance fraternity top information on the National Military Establishment and on industrial preparedness for our security and peace.

• In addition to these addresses and the others listed on this page, this issue also contains another article by Capt. B. H. Liddell Hart, noted British military analyst. Titled "The Red Army" (page 25) it is a sequel to "The Red War Machine" published in the May-June issue of ORDNANCE.

• Due to the extensive coverage of the proceedings of the Thirty-first Annual Meeting in this issue it has been necessary to postpone publication of many splendid articles until the September-October issue of ORDNANCE. The coming number will be a memorable one—one no A.O.A. member will want to miss. Watch for it!

—The Editors

A Program To Keep America Strong For Peace

TO KEEP ABREAST of the rapid and far-reaching advances in scientific and technical knowledge and their growing applicability to arms and to industry, the American Ordnance Association is devoting its energies to the following program for national security and peace:

To use all lawful means to ensure that the United States, its Government, Industry, and People

1. Strengthen in every way the close relationship among Science-Industry-Ordnance as indispensable factors of our national security and, to this end, foster close coöperation on the part of the Army, Navy, and Air Force with scientific and educational institutions.

2. Maintain a continuing national program of ordnance research and development, utilizing all facilities—governmental and private—for this purpose.

3. Inaugurate an annual ordnance replacement program to assure latest types of equipment for all our armed forces—ground, sea, and air.

4. Strengthen and increase in time of peace the fourteen decentralized Ordnance Districts.

5. Accumulate and maintain adequate reserves of strategic raw materials to safeguard our national security.

6. Preserve and strengthen our arsenals and depots—ground, sea, and air—to enable them, in coöperation with science and industry, to keep alive the knowledge of ordnance production and logistics in time of peace.

7. Train annually military and civilian personnel of the technical branches of the Military, Naval, and Air Forces in current industrial practices, and, similarly, train key scientific and industrial personnel in the technique of ordnance design, production, and logistics.

8. Establish and maintain Ordnance R.O.T.C. units at qualified educational institutions of our country and substantially increase the number of these units.

9. Educate all our people in the vital importance of planning not only for the mobilization of our national resources but also for their effective utilization wherever needed to keep war out of America.

10. Foster public interest in scientific, industrial, and military preparedness to keep America strong for peace ashore, afloat, and aloft.

A Guaranty of Peace

The American Ordnance Association, founded 1919, is a patriotic, educational, scientific, and nonprofit membership society of American citizens dedicated to scientific and industrial preparedness for the common defense as one of our Nation's strongest guaranties of security and peace.

AMERICAN ORDNANCE ASSOCIATION

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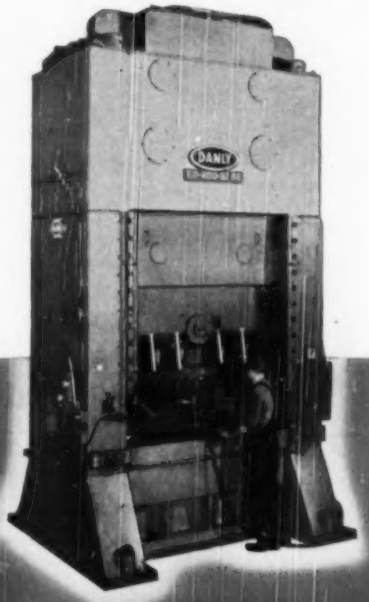
Like the heavy naval gun mounts, welded and machined by Danly, the frame of a Danly press is built to withstand the stress and strain of sudden high pressures. For example, bed deflections under load are held to a few ten-thousandths of an inch per foot of width.

The basic manufacturing facilities featured here are three of the reasons why Danly welded-steel press construction provides a stable, rigid foundation for long operating precision.



Danly 2-Point Steel Straight-Side Reinforced Press. Danly Presses are available in sizes from 30 to 3000 tons.

New DANLY Ventilated Press Clutch Gives Long Trouble-Free Service

Write for more facts today on the Danly clutch and other press features especially engineered to reduce press down-time and costly maintenance.

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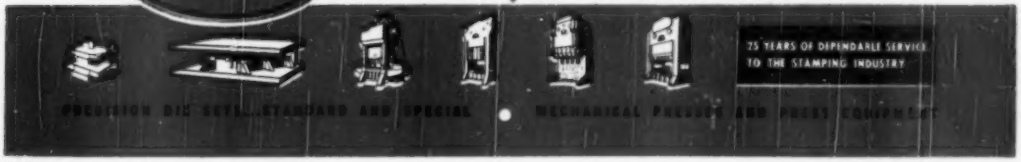
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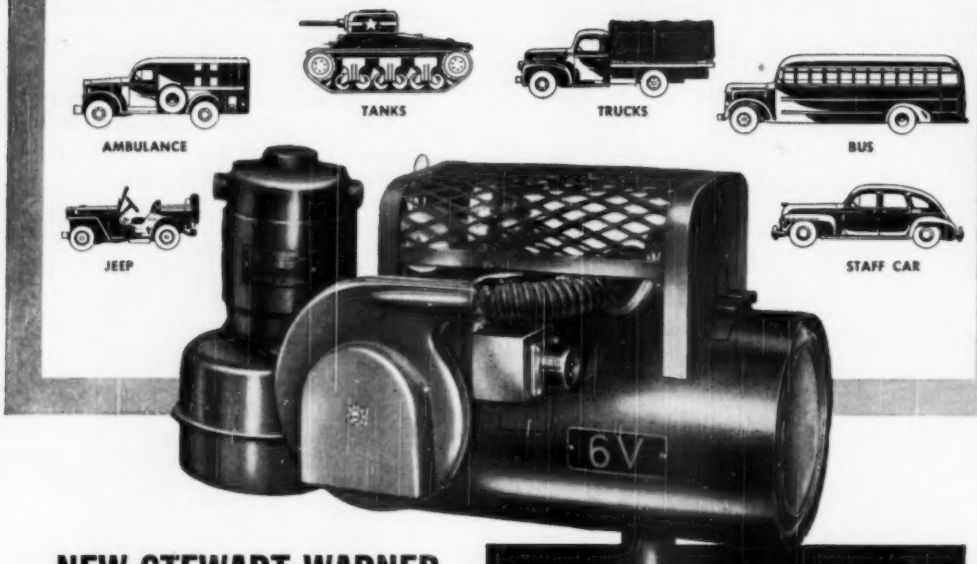
For Safe, Positive Heat in All Types of Military Vehicles!



NEW STEWART-WARNER Personnel Heater

South Wind 978

Stewart-Warner proudly announces another contribution to the military services—the NEW "978" Personnel Heater.

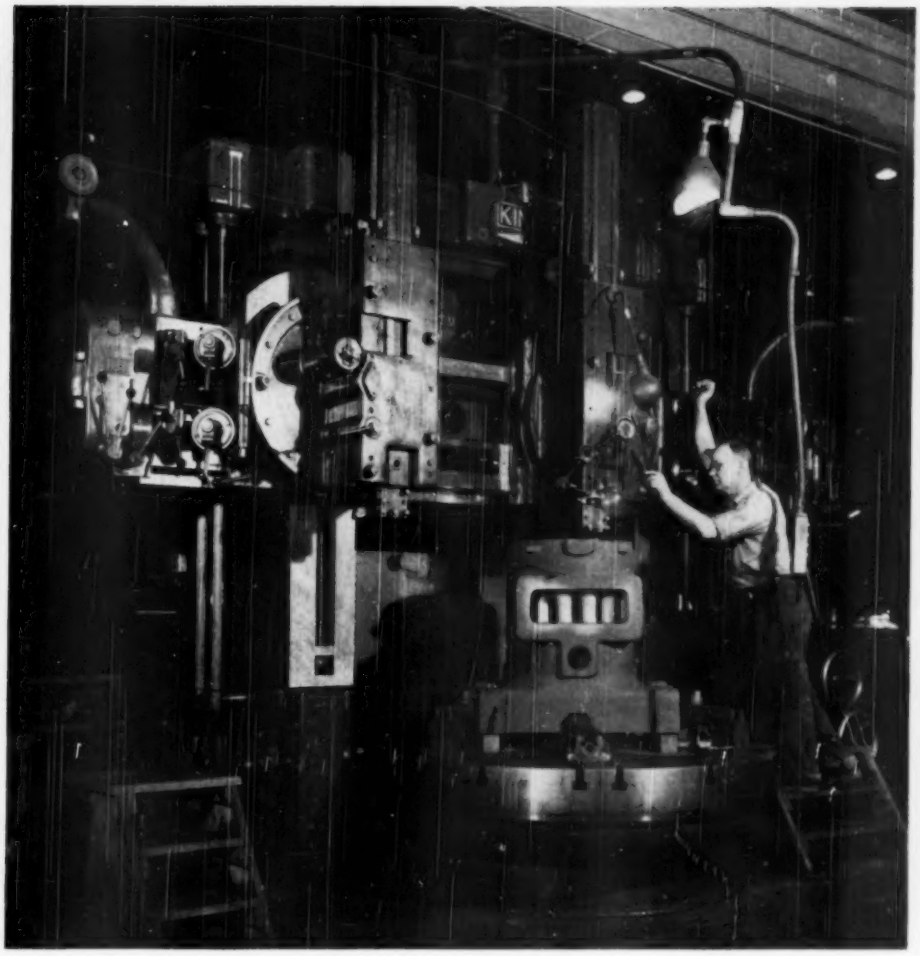
Developed in coordination with the U. S. Army Ordnance Department expressly for military vehicles, the "978" insures a plentiful supply of safe, dependable heat for personnel comfort and windshield defrosting in arctic temperatures *as low as 70°F below zero!* This heater is thermostatically controlled and available in 6, 12 and 24-volt models.

Complete installation kits, including simple installation instructions for a majority of military vehicles, are now in storage under their proper nomenclatures. Maximum inter-changeability of component parts is a design feature of these kits. A technical service manual and test equipment are also available to service organizations in the field.

Inquire *now* about this reliable new South Wind 978 heater, authorized for your vehicle or fleet.

STEWART-WARNER CORPORATION
South Wind Division
Indianapolis 7, Indiana

STEWART WARNER



Lower the Cost of Your Boring, Facing and Turning

New-Series KING Vertical Boring & Turning Machines have the extra weight, rigidity, and power essential for maximum results from use of modern cutting tools. A wider range of feeds and speeds plus simplicity of control assure adaptability for all types of boring, turning, and facing work—light or heavy, large or small.

The KING Way

KING machines are made in ten sizes: Single column, 30″, 36″, and 42″; Double column, 52″, 62″, 72″, 84″, 100″, 120″, and 144″. All sizes are available in a variety of head combinations, with or without side head. Complete description and specifications sent promptly on request.

American Steel Foundries

KING MACHINE TOOL DIVISION

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Builders of King Vertical Boring & Turning Machines and Sebastian Lathes

New BIG YELLOW ENGINES BUILT TO HANDLE BIG JOBS

MILITARY men who use construction equipment have learned from long experience to rely on "Caterpillar" Diesel power for trouble-free, long-life performance.

In addition to present models, four great new "Cat" Diesel Engines, ranging up to 500 horsepower, are now ready to supply continuous, dependable power for larger machines—such as shovels, draglines, ditchers, dredges, crushers and gravel plants. Every one of them is built to give long-life performance and true "Caterpillar" stamina. Every one is designed to burn low-cost, non-premium fuel —offering substantial savings.

The same advantages are built into four new "Cat" Diesel Electric Sets, generating up to 314 kw. These big units can supply main or stand-by power for airports, hospitals, water pumping, sewage disposal, post and camp lighting and many other military uses.

Full information and specifications on the new "Caterpillar" Diesel Engines and Electric Sets will be mailed to officers on request.

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When you figure casting costs, be sure to include the cost of handling and finishing. Alcoa Castings—sand, permanent or semipermanent mold, are held to such close tolerances that minimum machining is required. Result: you get castings that are competitive in cost per *finished piece*—and a big sales plus in aluminum's light weight, attractive appearance.
Call your Alcoa representative for more information and a prompt quotation. Or write ALUMINUM COMPANY OF AMERICA, 2137 Gulf Bldg., Pittsburgh 19, Penna.
Both Sand and Permanent-mold Foundries at each of the following cities: Bridgeport, Conn., Cleveland, Detroit, Los Angeles
ALUMINUM CASTINGS by ALCOA
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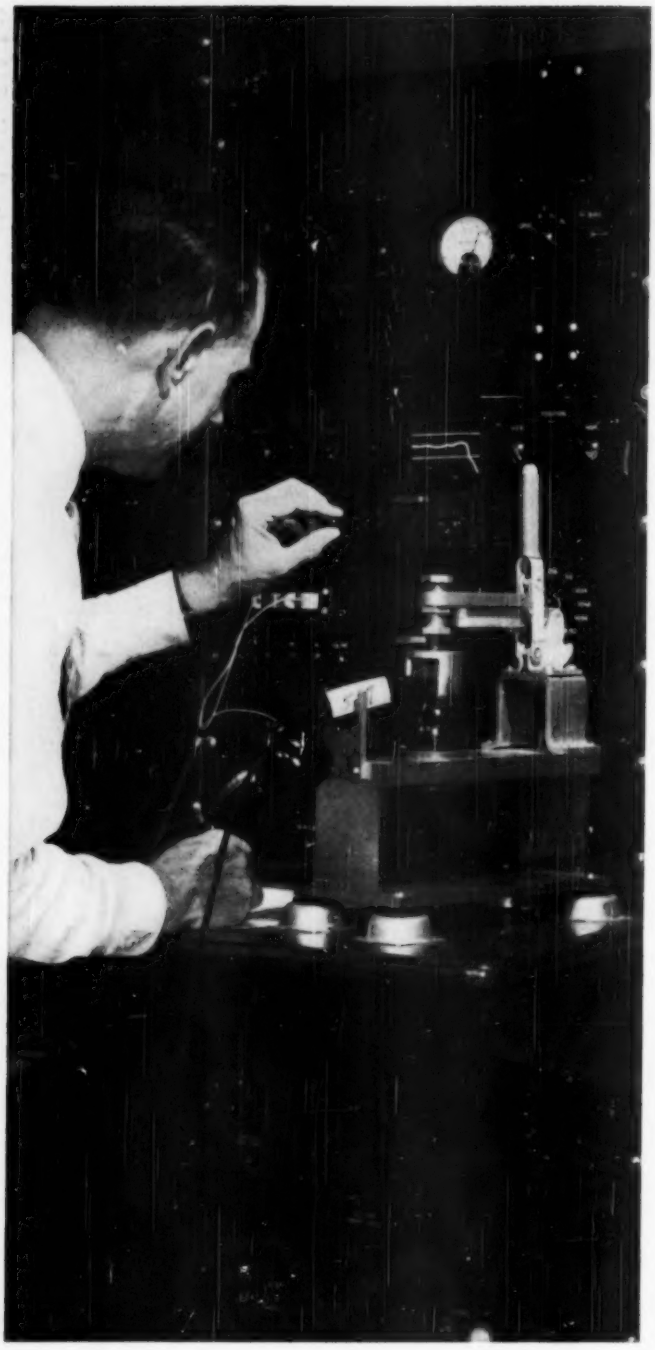


Your telephone receiver should treat each tone in the voice alike; that is important to you, because proper balance makes pleasant listening and easy understanding. Naturalness in receiver performance is pictured in a matter of seconds by the apparatus shown at left.

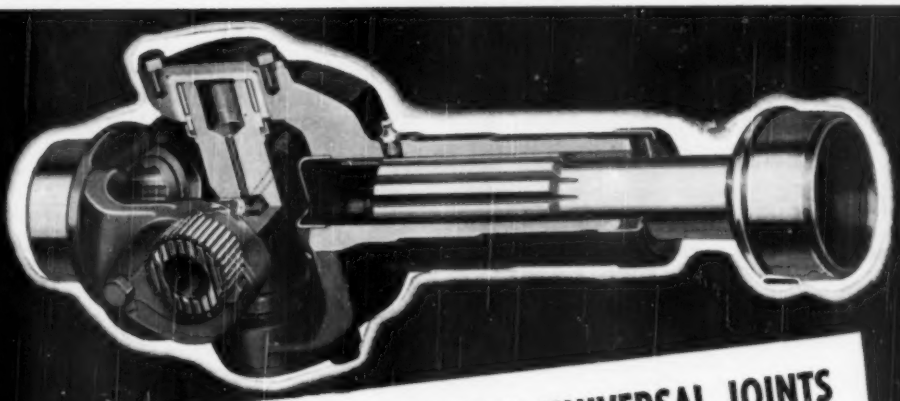
The receiver is clamped in place and an oscillator feeds into it frequencies representing all talking tones. Then a bright spot darts across an oscilloscope screen leaving behind it a luminous line which shows instantly the receiver's response at each frequency. It is precise; and it is many times faster than the old method of measuring receiver performance point-by-point and then plotting a curve.

It listens so YOU can hear better

At Bell Laboratories, development of techniques to save *time* parallels the search for better *methods*. For each time an operation is made faster, men are freed to turn to other phases of the Laboratories' continuing job—making your telephone system better and easier for you to use each year.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE.



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NEEDLE BEARING UNIVERSAL JOINTS

Offer Exclusive Features for Exceptional Services

Design—Rigid one piece forged steel yokes and journal cross carry full torque load and provide precision needle bearing alignment. Simple—sturdy—reliable.

Material—Carefully heat-treated steel forgings to resist fatigue and shock loads. File-hard bearing surfaces to resist wear.

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Balance—Spicer has unequalled facilities for maintaining very close limits of static and dynamic balance in all units.

Lubrication—After initial pressure lubrication, centrifugal action distributes reserve lubricant to bearing surfaces. Centrally located lubrication fittings allow refilling of lubricant reservoirs with shaft in installed position, without affecting original assembly or balance.

Types and Sizes—Every need in the automotive, industrial, and agricultural field is met by Spicer's broad range of designs and sizes.

Spicer engineers will help adapt Spicer Needle Bearing Joints to your particular needs.

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New Developments

FUTURE GUIDED MISSILES

Pilotless guided missiles, traveling at speeds of 1,200 to 1,500 miles an hour, supplemented by a few giant atomic-powered aircraft, will form the main backbone of the U. S. Air Force's offense and defense by 1960, John K. Northrop, pioneer aircraft designer, predicted in Washington, D. C., recently.

First of these will be a long-range winged missile propelled by existing power plants and capable of carrying large loads of high explosives. The know-how for this missile, operating for test purposes at speeds of about 600 miles an hour but capable of extension to 1,000 m.p.h., is presently available, he pointed out.

The second type of missile in the robot air fleet will be an interceptor which he predicted will almost completely supplant human-piloted fighter aircraft. Much smaller than present fighters, this "weapon" will be rocket-powered, equipped with automatic guidance devices, and will constitute the sole effective defense against a mass attack from enemy long-range missiles.

Nuclear-powered aircraft, Mr. Northrop declared, while having unlimited range and very high speeds, will be enormously expensive and therefore comparatively few in number. Except for specialized service, they will be inferior to the guided missile in their ability to deliver a war head to enemy territory at the lowest cost to our country's economy.

ARMY ASSIGNED LAND TRANSPORT

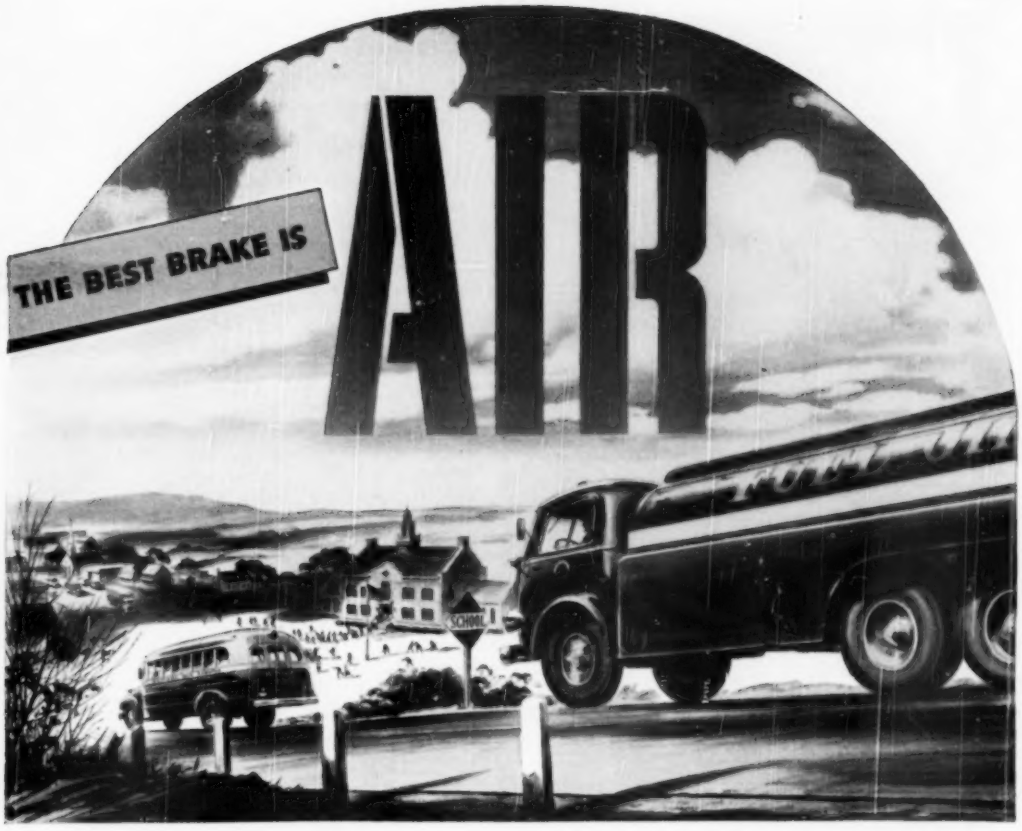
The Army has been assigned the responsibility for the operation of common-use military land transportation, including highway, railroad, pipeline, and inland waterway. This decision does not affect commercial land transportation systems in the United States. Pending further study, each Department will continue to make its own arrangements with commercial carriers for its transportation requirements. The Army will make plans and provide personnel and equipment for the operation of land transportation in overseas areas which are occupied by two or more of the services. Details of the consolidation of responsibility for land transport under the Army are being developed by the Joint Military Transportation Committee of the Joint Chiefs of Staff.

RADIOACTIVE GAGE

A new instrument which uses radioactivity to measure the thickness of sheet materials moving along a conveyor has recently been developed. Known as the "beta-ray thickness gage," the instrument bombards the material with beta rays. These are high-speed electrons which come from the radioactive substance strontium-90. The instrument measures the number of high-speed electrons passing through the sheet material being checked. This measurement is translated, by means of a complex electronic circuit, into terms of how much the sheets being checked by the gage vary from the desired thickness. The gage does not come in contact with the material it checks. Hence it can be used to monitor the thickness of rubber, plastics, textiles, and paper, as well as metal, without damaging the sheets in any way.

EARTH'S MAGNETIC FIELD

Three "Aerobee" rockets fired into the stratosphere from the U.S.S. Norton Sound collected data on the cosmic-ray intensity and azimuthal distribution through and above the atmosphere in an attempt to discover if the earth's magnetic field originates in the outer regions of the earth's atmosphere. The information



The Better the Brake—the Safer the Truck!

When you stop to think about it, no truck is any better than its brakes. That's why so many experienced men in the trucking business insist on Bendix-Westinghouse Air Brakes. They know you can rely on maximum control instantly—anywhere, any time. And with this extra security, trip speeds can be safely increased, heavier pay loads carried. On top of that, Bendix-Westinghouse Air Brakes require less maintenance. Overhead comes down because trucks stay on the job. Add up the advantages and you'll agree. It's good business to install Bendix-Westinghouse Air Brakes—the world's safest power-to-stop.

THE BEST AIR BRAKE IS

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• Continuous Strip and Sheet Galvanizing Lines
• Piercing Mills • Plug Mills
• Slitting Lines • Levellers
• Drawbenches

Aetna-Standard is known the world over for: seamless tube mills; continuous butt weld pipe mills; drawbenches for tubes and bars; coating equipment; strip finishing equipment and products listed above. We are continuing to work closely with The Army Ordnance division in the designing, engineering and manufacturing of ordnance materiel.

The AETNA-STANDARD ENGINEERING CO.
YOUNGSTOWN, OHIO

DESIGNERS AND BUILDERS to the Steel, Non-Ferrous and Chemical Industries

New Developments

obtained will materially aid in solving long-range radio transmission problems. The operation will also provide an excellent opportunity to gain experience in employing large rocket-type missiles on board a ship at sea and in training crews to handle and launch such missiles.

MERCURY POWER PLANT

The first postwar mercury turbine-generator, which uses mercury vapor instead of steam to drive a turbine, has recently been built by the General Electric Company. Capable of producing 15,000 kilowatts of electricity, the new installation includes a mercury boiler in which mercury is heated into vapor, just as water is heated into steam. The mercury vapor not only can drive a turbine which in turn drives an electric generator but also can supply extra heat for producing steam for other turbine-generators.

FASTEST HELICOPTER

The U. S. Navy now has the world's fastest and highest performing helicopter designed specifically for operational use with the fleet—the XHJP-1. In trial speed runs at the Piasecki Helicopter Corporation's plant at Morton, Pa., one of the streamlined tandem-configuration helicopters made calibrated runs at 131 miles an hour. This mark unofficially surpasses the present world's record of 124.315 miles an hour for rotary-wing aircraft held by the British Fairey "Gyrodyne." The new craft also has shown an unusually fast rate of climb of better than 1,600 feet a minute in forward flight and 1,500 feet a minute vertical rate

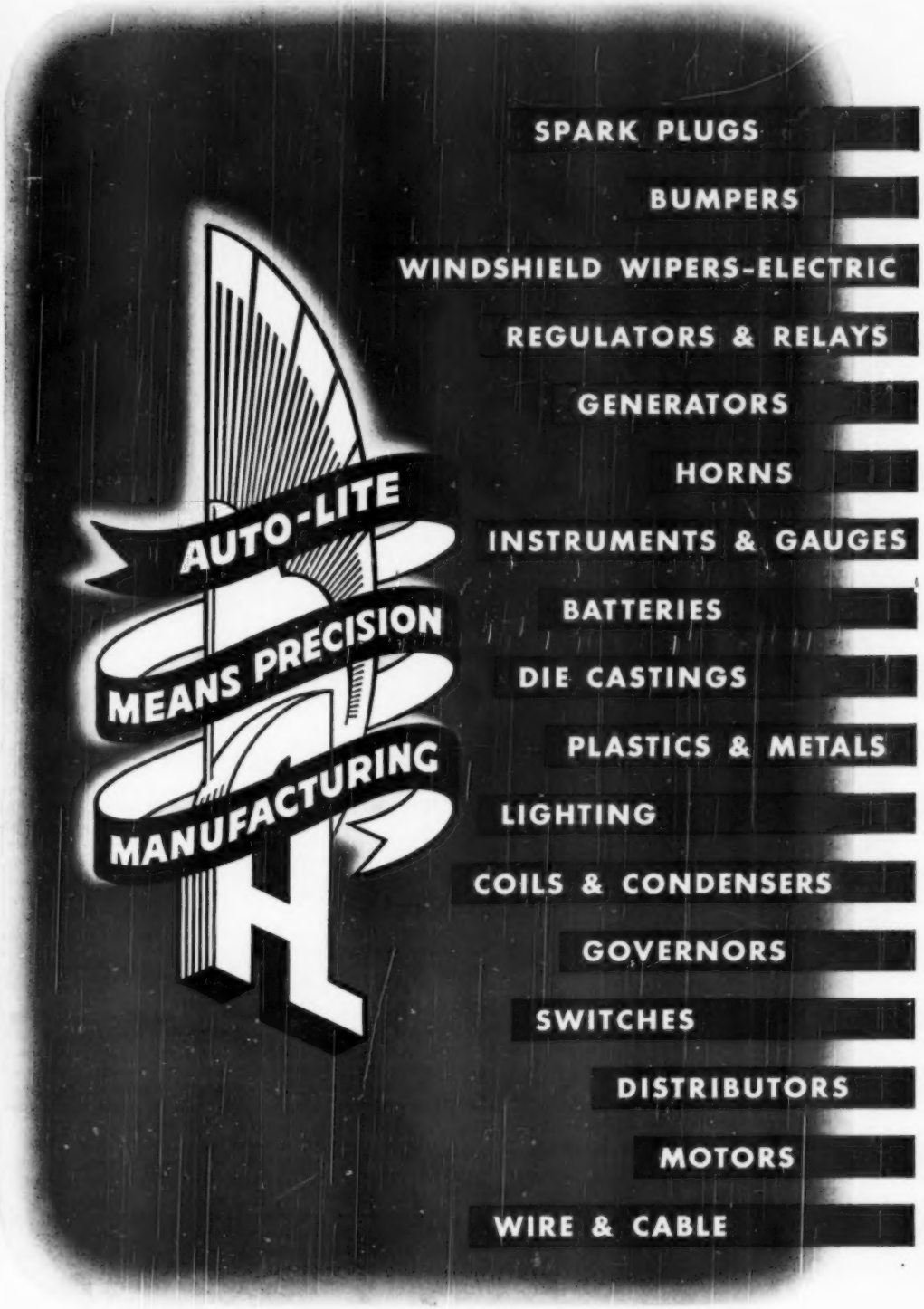
The XHJP-1 Helicopter

of climb. At 75 per cent power, the cruising speed of the XHJP-1 is 114 miles an hour, equaling the American helicopter speed record.

The helicopter features a big internal rescue hatch adjacent to the pilot's seat which is large enough to permit passage of a ladened litter. The hydraulically operated hoist is mounted above the hatch so that rescued personnel can be brought directly into the cabin. Regardless of the most adverse weather during rescue operations, the pilot can watch and control the rescue while flying the helicopter with precision. If a rescue sling or harness is used, the pilot can conduct the entire operation without assistance. Powered by the new Continental R-975-34 radial air-cooled engine, rated at 525 horsepower for take-off, the XHJP-1 normally carries a crew of two and five passengers.

MILITARY PURCHASING GUIDE

An "Index of Military Procurement," showing which military purchasing offices have been assigned the responsibility for buying products now covered by the Army-Navy-Air Force coordinated purchasing program, has been made public by the National Military Establishment. Under the coordinated program each service has been assigned certain items to buy for all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MANUFACTURING
SPARK PLUGS
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WINDSHIELD WIPERS-ELECTRIC
REGULATORS & RELAYS
GENERATORS
HORNS
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BATTERIES
DIE CASTINGS
PLASTICS & METALS
LIGHTING
COILS & CONDENSERS
GOVERNORS
SWITCHES
DISTRIBUTORS
MOTORS
WIRE & CABLE

Skeet shooters demand superior shotgun shells because one "missed bird" can lose a championship. The world-wide popularity of Western XPERT and Winchester RANGER Super Skeet shells is the best evidence of the superiority that America recognizes in *all* of OLIN'S many products.

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three Departments. In some cases, the purchases are made jointly. For example, the Navy buys hand tools for the three Departments, the Army buys automotive equipment, and the Air Force buys photographic equipment. As an example of joint purchase, the Armed Services Petroleum Purchasing Agency buys petroleum, oils, and lubricants for Army, Navy, and Air Force.

NEW FUEL FOR JETS

A new fuel has been developed for jet-propelled aircraft which will make more jet fuel available per barrel of crude oil than the old type of kerosene (JP-1). The new fuel, known as AN-F-58 (Army-Navy Fuel No. 58), is basically a gasoline-type fuel with an octane rating varying between 50 and 65. The fuel was developed by the Air Force, Navy, NACA, and the petroleum industry.

By changing the process of distilling crude oil and blending the distilled products, a higher percentage of usable jet fuel is produced from a given quantity of crude oil than with the prior method of producing kerosene. Despite an increasing use of jet aircraft by the Air Force, less crude oil will be required to supply jet engine fuel than would have been required using the kerosene-type fuel.

USAF MISSILE TRAINING

The Air Force recently announced a program to purchase guided missiles and allied equipment to be used in a new training program of guided-missile launching crews.

Two Air Force guided missiles were also revealed for the first time. One is the Consolidated Vultee 774, thirty-two feet long and the first Air Force missile approaching the size of the German V-2, which is about forty-five feet long. The second is a smaller rocket test missile, the North American NATIV. It was fired at Holloman Air Force Base, Alamogordo, N. Mex. The NATIV is approximately thirteen feet long. Both missiles are powered by liquid-fuel rocket motors, and both have reached supersonic speeds.

OVERCOAT FOR ALUMINUM

A recently developed chemical provides a quick, simple protective treatment for aluminum and its alloys. Known as "Alodine," the chemical reacts with the metal to produce high corrosion resistance and durable paint bonding, it is claimed. Alodine can be applied to aluminum parts by dipping, spraying, or brushing so that the process offers much greater latitude than either chemical or anodic oxidation. Many types of aluminum structure and subassemblies can thus be effectively treated; large assemblies like airplanes, buildings, etc., can be successfully treated in the field.

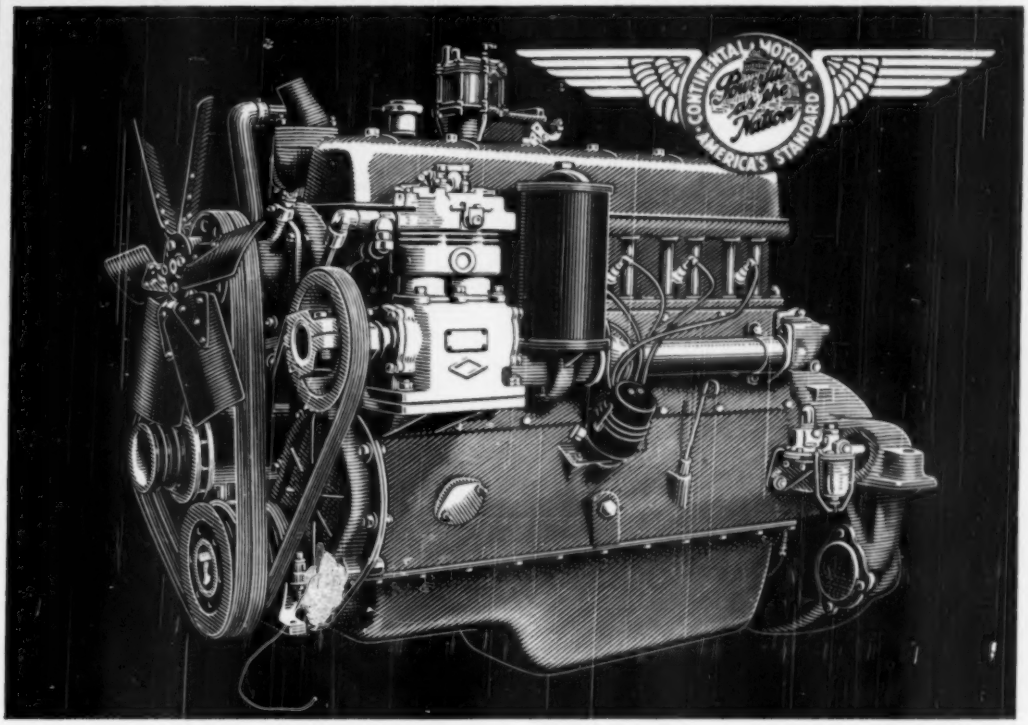
DEFUZING BY TELEVISION

The Ordnance Department of the Army recently revealed that it has developed a method for safely removing fuzes and boosters from high-explosive bombs and projectiles by means of a television camera which transmits an image of the work being done to an operator who manipulates remote-control tools from a bombproof shelter. The dangerous missiles may also be completely disassembled by the same method.

Developed during the war as a vitally needed safety measure, the system is now unveiled in the hope that it may help American industry reduce the danger to personnel in various hazardous manufacturing operations.

The television equipment, made by Remington Rand, Inc., transmits its impulses over a coaxial cable. The camera, receiver, and power unit are all portable and do not require highly trained technicians to handle them.

RED SEAL ENGINES



NEVER BEFORE ENGINES LIKE THESE

S-6820:	270 h.p. at 2600 rpm.
S-6749:	250 h.p. at 2600 rpm.
R-6602:	200 h.p. at 2600 rpm.
R-6572:	190 h.p. at 2600 rpm.
R-6513:	170 h.p. at 2600 rpm.
U-6501:	165 h.p. at 2600 rpm.
T-6427:	150 h.p. at 2600 rpm.
T-6371:	130 h.p. at 2600 rpm.
B-6427:	130 h.p. at 2600 rpm.
B-6371:	100 h.p. at 2600 rpm.
M-6330:	105 h.p. at 2800 rpm.
M-6290:	95 h.p. at 2800 rpm.
M-6271:	90 h.p. at 2800 rpm.
F-6226:	75 h.p. at 3000 rpm.
F-6209:	70 h.p. at 3000 rpm.
F-6186:	60 h.p. at 3000 rpm.
F-4162:	55 h.p. at 3000 rpm.
F-4140:	50 h.p. at 3000 rpm.
F-4124:	45 h.p. at 3000 rpm.
Y-4112:	45 h.p. at 3000 rpm.
Y-4091:	35 h.p. at 3000 rpm.
Y-4069:	25 h.p. at 3000 rpm.

Continental Motors now offers a matchless line of large overhead-valve engines designed especially for transportation. Produced in sizes from 150 to 250 horsepower, these up-to-the-minute power plants make possible a new concept of heavy truck and bus design.

PERFORMANCE Being designed to operate at higher r.p.m., these engines open the way for the use of higher gear ratios, resulting in the faster pick-up, better climbing characteristics and higher road speeds which add up to FASTER SCHEDULES.

EASE OF SERVICING Parts requiring occasional adjustment or service are quickly accessible, to minimize time out. Overhead-valve assemblies come off as a unit. Tappets are easily removed and replaced from above.

NEW FUELS These engines, supplied today with heads adapted to 75 octane gasoline, are designed to use new fuels, with improved performance and economy, as such fuels become available. Most models can be adapted to butane and several have counterparts in Continental's Diesel line.

BUILT FOR THE JOB!

Continental Motors Corporation
MUSKEGON, MICHIGAN

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Research and Development

Dr. Karl T. Compton Directs Key Defense Program

WORLD WAR I provided a clue to the significance of modern technology in warfare: The submarine and submarine-detecting devices, the airplane, the tank, gas, and sound-ranging of artillery then had their first military use. Though important, none of these was decisive—although the submarine came close to being decisive against us.

But in World War II, for the first time in history, the conflict was decided by weapons largely or entirely developed and produced during hostilities. This fact was the outstanding military lesson emerging from this war as rocket weapons, guided missiles, and homing torpedoes proved their effectiveness.

This lesson was taken to heart by the military authorities, the Congress, and the public, though the idea was not entirely new. It was believed, for example, that more money spent for research, at the sacrifice of less for current construction, would enable us to forge ahead of our competitors technically after a few years. But it took World War II to demonstrate—so vividly that there could be no dissent—the soundness of such a policy.

As a result of this lesson, and stimulated by the dangers inherent in the postwar conflict of ideals and objectives between the great democracies and the Soviet Union, the Congress has adopted policies of vital significance for the preservation of our national security and the peace of the world.

One of these policies is the largest military budget in our peacetime history. Research and development takes a little less than four cents out of every dollar spent for our Military Establishment. This sum of approximately $550,000,000 does not include the sums separately provided by Congress for the Atomic Energy Commission.

As citizens and taxpayers we are deeply interested in the efficiency with which this money is used and the value of the results for which it pays. Are we spending enough or too much on this aspect of national security? The answer is to be found in the organizational structure and activities of the Research and Development Board.

The Board is composed of six high-ranking officers, two each from the Army, Navy, and Air Force, with Dr. Karl T. Compton, noted educator and scientist as civilian chairman.

Dr. Compton was appointed as chairman of the Board by the President on October 15, 1948. In order to devote full time to this important task, he resigned the presidency of Massachusetts Institute of Technology, a position he had held with distinction since 1930.

Dr. Compton was one of the original members of the National Defense Research Committee and later also became chief of the Office of Field Service, OSRD, directing the dispatch of scientific experts into the theaters of war to assist in the fullest exploitation of the new weapons then being issued to our troops.

During World War II he was also a member of the Scientific Intelligence Mission to Japan; a member of the Secretary of War's Special Advisory Committee on the Atomic Bomb; chairman of the United Radar Mission to the United Kingdom; a member of the Baruch Rubber Survey Committee; and a member of the War Resources Board. His photograph appears on the front cover of this issue of ORDNANCE.

Reporting to the Research and Development Board are eighteen committees, each composed of three civilian experts plus two officers each from the three services. Reporting in turn to these committees are approximately one hundred technical panels, likewise composed jointly of civilian and military members and covering such specialties as radar, metallurgy, airplane power plants, and psychological warfare.

A planning division concerns itself with the designing of methods of operation and the formulation of objectives, and a programs division is charged with assembling and classifying all pertinent information regarding the 18,000 research and development projects which currently appear in the programs of the military Departments.

At the present time there are more than 300 full-time employees and about 2,300 part-time members of the whole Research and Development Board organization.

The Joint Chiefs of Staff provide the Research and Development Board with numerical ratings on the relative strategic importance of the various major types of military operations in the light of the possible eventualities which they can foresee.

Under these main operational categories, the Research and Development Board breaks the requirements down into over 200 principal technical objectives, such as radar and submarine detection. These technical objectives are, in their turn, arranged in priority groups on the basis of adequacy and promise.

Finally the numerical estimates of strategic importance from the Joint Chiefs of Staff and of adequacy-promise from the Research and Development Board are put together to give a combined figure to each technical objective which serves as a guide to the Departments as to the significance which they should attach to research and development projects in the field of that technical objective.

DR. COMPTON is particularly proud of the fact that these figures now provide guidance never before available in this country, incorporating as they do both the strategic thinking of the Joint Chiefs of Staff and the technical judgment of the Research and Development Board. This program is designed to meet the military and technical requirements of our national-defense system as effectively as possible.

Our National Military Establishment is securing high value from the research and development work now being carried on by Dr. Compton and his competent and devoted associates. The American people can rely on them with confidence to keep the United States abreast of the latest technological developments ashore, afloat, and aloft.

PHANTOM FIGHTERS of Marine Fighter Squadron 122 take to the sky in a striking demonstration of jet-propelled aerial firepower (Marine Corps photo).

Working for Peace

PEACE is the most important business in the civilized world today. It is also the most urgent. For today time is the most precious commodity the world has ever known in all its history.

¶ Our quest for peace leads along a very narrow road. On one side is the precipice of a possible Third World War—and we have been uncomfortably close to the edge on several recent occasions. The precipice is still there. On the other side lurks the no less dangerous swamp of economic chaos—and its insidious spread already threatens to narrow still further the road ahead.

¶ In brief, our problem is not only to achieve peace—but also to avoid bankruptcy. The only way to "win" a war nowadays is to prevent it from getting started. Otherwise, the wilderness may well be the only "victor."

¶ The *ultimate* cost of our participation in the Second World War, including expenditures already made and commitments already assumed, will approximate one trillion, four hundred billion dollars—and it will take us more than one hundred years to pay for it. We cannot afford an encore!

¶ In our past efforts to secure peace, we have tried limitation of armament, "peace" treaties, isolationism, armed neutrality, pious resolutions, moral suasion, threatening notes, appeasement, and pacifism. The only trouble was that none of them worked. We found no peace.

¶ Now we have embarked on a program which recognizes the stark reality that military, naval, and air power backed by American science, engineering, and industry are the essential ingredients in any formula not merely to "win" a war—but to avert war altogether.

¶ As the President said on January 20, 1949: "If we can make it sufficiently clear in advance that any armed attack affecting our Nation's security would be met with overwhelming force, the armed attack might never occur."

¶ *Obvious* overwhelming retaliatory potential may well deter gangster nations from a career of world conquest.

¶ During the Second World War our logistical superiority in firepower and mobility offset the numerically greater numbers of enemy troops in every theater of operations —and reduced our battle deaths to twenty per cent of our enemies'. The job ahead is to reduce our battle-death expectancy to zero.

¶ The critical and controlling factor in attaining "overwhelming force" is, as always, the noncommercial articles required to arm our manhood—ordnance. We can either stock-pile ordnance or stock-pile the "know-how to produce ordnance" promptly, of superior quality, and in adequate quantity. Stock-piling know-how will cost us only one-half of one per cent of the cost of building up reserve stocks of the tools to enforce peace.

¶ Peace is the high goal of all activities of the American Ordnance Association. Insuring peace without bankrupting our economy is the narrow target of all our endeavors.

¶ The chairmen and members of our twenty-nine Technical Divisions and Committees, backed by the entire membership of the Association, have attacked this problem in a uniquely American way—voluntary action without compensation whenever requested by our Government's authorized representatives.

¶ The record of production problems solved is the best evidence that the American Ordnance Association is effectively working for peace.

James L Walsh

President, American Ordnance Association

The Core of Security

Science, Industry, and the Armed Forces United

by

Gen. J. Lawton Collins

To avoid disaster, we must be able to utilize all our strength quickly without fumbling, error, and second trial

General Collins, a distinguished officer of wide administrative and field experience, is Vice Chief of Staff, U. S. Army. He was the main speaker at the Thirty-first Annual Dinner Meeting of the A.O.A., held at the Hotel Ambassador, Los Angeles, April 26, 1949.

SPEAKING for the fighting men whom I had the great privilege of commanding during World War II, I can state that you and your associates—those in the Army, Navy, Air Force, and in industry—made us feel that we were not on our own, that we did have behind us and in our hands not only great weapons but also the tremendous power of American industry.

I like to think of our national-security structure as resting on a base with three legs. The armed forces is only one of them. The other two are science and industry, and if a very fine balance is not maintained among these three, our national security would be upset. If any one of the three is neglected, or if any one is inordinately developed at the expense of the others either in money that has to come from the taxpayer's pocket or in interest or initiative, then national security is bound to suffer. We've come a long way since the days when there was no coördination among these three.

When I was a cadet at the Military Academy in 1917 it was quite apparent that ultimately we were going to get into World War I. We had a very unusual officer there named Joe Stilwell. Joe was an instructor in an academic subject, but his heart actually was in light automatic rifles. I can well remember his inviting the members of the first class who were interested to go down after our normal hours to see him try to improve the old Benét-Mercié machine rifle. Some of you here probably have never heard of it, but it was one of the rifles with which we started to fight the first World War.

Because of the lack of coördination plus, I must say, the lack of interest on the part of the American people and scientists who did not come to the aid of industry and the armed forces, we had to enter World War I with such a weapon. We also had to use such weapons as the French 75 which, fine as it was, even then was outmoded. We had to train our men with wooden rifles. We had to practice with wooden tanks or with trucks representing tanks.

Planning for M-Day

In the interim between wars we progressed somewhat, and we developed a plan which, I am proud to say, was initiated very largely by the Army Industrial College under the leadership of men like Mr. Johnson, now our Secretary of Defense, and others who preceded him. It was a mobilization plan which did attempt to coördinate and to adjust the relative demands of science, of industry, of the armed forces, and of our civilian population.

Unfortunately that plan was not put into effect when World War II came along, and again we were left with improvisations, extemporizations, trials, and errors. Largely, the reason for this unfortunate state of affairs was that people were still afraid of the military, or of industry—and even perhaps of science. I can well remember again that in the interim between wars, when we were endeavoring to set up experimental orders, the member of the Congress who later accused us of being slow in mechanizing the Army was the one who led the attacks against educational orders and against the establishment of the Ordnance districts, which were just then being formulated. He said that the military would take over the running of the industry of the United States!

There was a fear that the controls by any boards which might be set up would wreck this country. Just as it proved false that the military would endeavor to seek power along this line, so also, if people had thought back to the operations of Mr. Baruch, they would have known that we need not fear the top men of industry.

I think one of the least-known things about Mr. Baruch was the fact that when President Wilson placed him in charge of the War Industries Board he accepted it on one condition only—that he would have the complete power of decision of that board. Mr. Wilson gave it to him. Nevertheless, Mr. Baruch's board voted on every issue that arose, and he cast his one vote along with all the other members despite the fact that he alone had all the power.

We Floundered Around

I should have thought, then, that we would have been willing to accept the leadership of men of industry and men of the armed forces when World War II began. But unfortunately that was not done, and so we floundered around in getting our industrial production under way.

I hope that we have learned our lesson. Certainly, under the new Unification Act, we now have the necessary structure to avoid these errors. Now the policy is set at the very top level of government in the National Security Council, which is provided for by the Unification Act. This Council is headed by the President of the United States, the other members being the Secretary of State, the Secretary of Defense, and the Secretaries of the Army, Navy, and Air Force Departments plus another very important man—the head of the National Security Resources Board, which is an agency of the National Security Council.

Work of the Board

This Board has the business of balancing the demands of the civilian economy against those of the military, allocating production, allocating steel, and doing the myriad things that formerly were done by the War Industries Board. The National Security Council, with the aid of the National Resources Board, must form the basic policies which govern the operations of the military. With this guidance the Joint Chiefs of Staff are ready to set up plans to attain our strategic objectives.

Here again there is a very important link in this essential coördination, because these plans must be checked not only by a subcommittee composed solely of military men, an agency of the Joint Chiefs of Staff, but also by the Munitions Board which is made up of the three Under Secretaries of the three Departments plus a civilian head who has the power of decision.

Therefore, all our plans, if this system is followed, will now be well-coördinated and well-balanced. To show that the Munitions Board takes its job seriously and is doing a good job, I should like to mention a recent case in which it turned down a rather important plan that the Joint Chiefs had been working on with the simple statement that it could not be implemented by industry. The Joint Chiefs have changed the plan accordingly.

Of course, in our planning there is a continual byplay back and forth among the armed forces, science, and industry. Usually the military people will set up a requirement for a certain item. Take, for an example, the development of a certain type of equipment which we found we needed in Normandy. After we had landed the question arose as to how we would break out from the beachhead. We were in hedgerow country—small fields one hundred yards square separated by tremendous hedgerows of mud and roots of trees which formed natural fortifications for the Germans. On either flank were swamplands, and German mortars located behind the hedgerows were causing tremendous casualties among our men. Thus it was a question of a frontal attack; if we tried to envelope these positions we would run into swamps.

Call for Radar

We had no satisfactory way to locate the deadly mortars, so we sent out a hurried call for the development of some device by which we could find their position and then bring fire down upon them.

The order came in too late; so we broke through by using great air power and tank power. But before the war ended an adaptation of radar had been evolved by the scientists whom we had asked to help us, and later we were adjusting artillery fire by radar locators. Units to operate these devices were set up, and the people who handled them got to know what all the pips on the radar screen were. When anything new appeared, they knew it had to be either a new dump, a concentration of troops, or something moving up. More than one German concentration was counter-attacked and broken up by artillery fire even though nobody had actually seen the target.

We received this sort of help throughout the war because the Ordnance Department and the other agencies of the Department of the Army sent teams right up to the front with new weapons to teach us how they worked.

Actually our casualties during the past war were twenty per cent of those of our enemies, despite the fact that usually we were fighting against greater numerical odds.

With this application of science and industry, plus expert development in our army, we—a peaceful, democratic people—succeeded in World War I and in World War II by being able to cross the seas under the protection of our Navy and beat our enemies at their own game on their own ground.

The problem ahead of us now, perhaps, is to perform another miracle—the miracle of peace, the miracle of preventing another of these damnable wars. We can do it only if science, industry, and our military forces again have confidence in one another and work together to build up a strong America that no one will dare to attack.

Navy Weapons Development

Rear Adm. W. G. Switzer
Commander, U. S. Naval Ordnance Test Station
Inyokern, Calif.

In the fast-moving field of weapons development for modern warfare, we cannot stand still. At the U. S. Naval Ordnance Test Station at Inyokern, Calif., the development of new and more effective rockets is proceeding at an accelerated rate, particularly in the air-to-air field where higher velocities and cleaner designs are rapidly becoming available. Revolutionary developments in the field of underwater propulsion and control systems are in prospect, which give promise of wide application beyond the specific field for which the development was started.

We at the Naval Ordnance Test Station realize fully that the main reliance of the Nation for the development of weapons rests with private industry, but we feel that Government facilities such as this have a very definite place in the weapons development program. That lesson was learned in the last war. The 600 professional technicians and several thousand other persons who are working at Inyokern must keep abreast of weapons development in times of peace.—*Admiral Switzer made these remarks during an illustrated lecture at the Ordnance Technology Conference of the Thirty-first Annual Meeting of the A.O.A., Hotel Ambassador, Los Angeles, April 26, 1949.*

Proving the Rockets

Army, Navy, Air Force Operations at White Sands

Brig. Gen. Philip G. Blackmore

The success of the proving-ground activities has been due to the splendid coöperation of all the participating agencies

THE primary mission of the White Sands Proving Ground is to provide facilities for firing rockets and guided missiles, and to record the data connected with their flight. The missiles are designed and manufactured by private industry and brought to the proving ground for test. Rockets which have been fired include the V-2, the Viking, the Hermes, the Aerobee (a Navy rocket), the MX-774 (an Air Force rocket), and a series of rockets which have been designed by the California Institute of Technology.

When a rocket is fired, information is recorded within the rocket itself and also at various different types of station on the ground. Telemetering stations receive and record on moving-picture film messages broadcast from the rocket. The present telemetering systems have thirty different channels. Other ground stations are concerned with tracking the rocket during its flight.

Cameras installed at three stations each a mile from the launching site give accurate data for the first mile of the rocket's flight. Each of these cameras points directly at a graduated pole which is almost in line with the launching site. The camera remains fixed in position, but exposures are recorded on a moving film at the rate of thirty per second. As the exposures from the three cameras can be synchronized, the trajectory of the rocket can be computed by film measurement and triangulation.

Phototheodolites at about fifteen stations have two parallel optical systems, one for the observer and one for the moving-picture camera. On each frame of the film the dial readings for azimuth and elevation are recorded, as well as the picture of the rocket. Here again the trajectory can be computed by film measurement and triangulation, but the rocket can be followed much farther along its course. Tracking telescopes are used similarly but have more power.

Radar and Doppler

Two types of electronic equipment are used to track the target throughout its flight. One is a radar system operated by the Signal Corps Engineering Laboratory and the other is a Doppler or Dovap system operated by the Ballistic Research Laboratory.

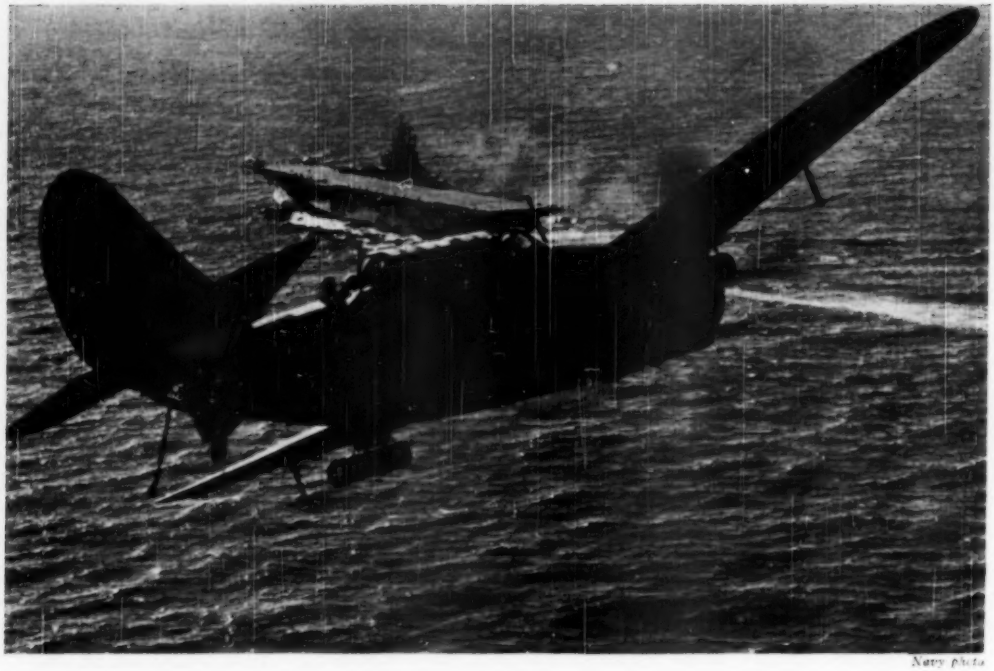
The radar system includes a modified wartime SCR-584, a beacon or responder in the rocket, and an automatically operated plotting board. The accuracy is somewhat approximate, but a plot is made while the rocket is in flight. As this information is immediately available it is used for safety control; if the rocket is in danger of going off the reservation a radio impulse is sent out to shut off the fuel supply or to blow the head off the rocket.

The Doppler or Dovap system is very accurate indeed, but the plot of the path of the rocket is not available until after an almost unbelievable amount of computation has been performed. A continuous radio signal is sent out from a ground station. This continuous signal is received at four other ground stations and at the rocket. The signal received at the rocket activates a transmitter in the rocket which sends out another continuous wave, which is received at the ground stations. Due to the movement of the rocket along its path, this wave is somewhat out of phase with the wave sent out from the ground station. The two waves are combined at each ground receiving station and produce a third wave, the frequency of which is not constant. It increases as the velocity of the rocket increases, and decreases as the velocity of the rocket decreases. This third wave is recorded on a motion picture film, which is sent to the Aberdeen Proving Ground for evaluation.

General Blackmore, commanding general of White Sands Proving Ground, N. Mex., delivered these remarks during the Ordnance Technology Conference of the Thirty-first Annual Meeting of the American Ordnance Association, held at the Hotel Ambassador, Los Angeles, April 26, 1949.

As time from take-off of the rocket is also recorded on the film in half seconds, it is possible to count the number of waves and the number of time signals and hence determine not only the velocity of the rocket at any time but also the distance from the ground to the rocket at any time. As such a record is made at each of four ground stations, the path of the rocket can be reconstructed by triangulation.

The splendid coöperation between the many civilian, Army, Navy, and Air Force agencies at White Sands is due largely to interest in the work, but the very looseness of the organization is also important. There is an honest effort to understand each other's problems and to assist in their solution. Conflicting interests can usually be reconciled. There is considerable mutual admiration and a great deal of pride of accomplishment. I believe that White Sands Proving Ground has already achieved a very large measure of that coöperation between services which Secretary Johnson has set out to attain.



Navy photo

Sea Power for Peace

Adequate Naval Forces May Prevent Another Conflict

Rear Adm. Albert G. Noble

I AM most appreciative of the opportunity of being present at this annual meeting of the American Ordnance Association and am particularly pleased that the meeting is being held in Southern California. Due to the long number of years which I have spent in Southern California waters, I feel as though it were a homecoming for me. My tours of sea duty from 1921 to 1939 were all spent in ships basing either in the Long Beach area or the San Pedro area. I am sure that you all remember the days when the strength of our battle fleet rode majestically at anchor off Long Beach and when our destroyer and submarine fleet were at San Diego.

The recollection of the sight of our battleships and aircraft carriers lying off your shore will always, I am sure, remain firm in your minds as well as in mine. We appreciated then, and I am confident that we appreciate now, that this visible strength of our armed might gave confidence of the maintenance of our national security. Especially did it give confidence of our Nation's ability to use the sea lanes for the purpose of conducting free trade throughout the entire world.

Sea Power Means Freedom

Those ships, the PENNSYLVANIA, NEW MEXICO, IDAHO, SARATOGA, LEXINGTON, AUGUSTA—to mention only a few—have now departed. However, the sense of security which they represented in bygone days is symbolized in other craft of different types but equally as capable of maintaining open for our free intercourse of trade the sea lanes and oceans of the world. It is this naval strength which gives to us a freedom of action which is denied to any other nation not possessing it. The influence of sea power has some aspects of being intangible, but it is a hard reality for those who do not possess it.

Sea power, the ability of a nation to use the seas for her own purposes, has been a decisive factor in the world's history. The very existence of a Christian Europe was made possible by ancient nations which used sea power as a tool in their struggle to prevent alien cultures and philosophies from overrunning Europe. Many years ago the Greeks defeated the navy of Xerxes at Salamis to keep out the Persians. Two centuries later, young Rome destroyed Carthaginian sea power to end this menace forever.

In the ancient times it was control of the Mediterranean which decided the military issues. Rome ruled the entire known world through her absolute domination of *Mare Nostrum* at a time when there was no other sea to be crossed. Now once again it is sea power—American sea power—which is helping to oppose the further expansion of an alien ideology into Western Europe. It is conceivable that the success of our efforts to preserve a Chris-

tian democratic world will depend on our ability to control the seas. They remain, as they have always been, wide and wet and deep, lying between us and the rest of the world. They can serve either as barriers or as bonds to unite us with our friends and allies. By the grace of God and American naval power they are today the highroads over which will flow the trade which keeps us great. Only as long as we are capable of enforcing our right to sail the seas at will, at times and places of our own choosing, can we maintain either the economic or military potential on which rests American world leadership.

The United States alone of nations has the naval power to keep all our seas open and to deny their uses to an enemy. The very lack of any surface opposition serves only to spotlight the power we can share with our allies. Two thirds of the globe is covered by water. Adequate naval forces can control the surface of that water—and the air above it and the depths below it—to give us an initial domination of most of the world at the *start* of a future conflict.

We Control the Sea

Our sea control is a physical fact. Any potential enemy who lacks it is forced to the uses of undergrounds and subversives to injure or destroy us. Our freedom of movement and flexibility of attack anywhere in the world are preserved, as are the bonds which join us to every ally we may have.

An adequate and effective naval force able to exercise control of the seas for us requires many things. It must have the tools to operate offensively and defensively against enemy opposition—submarines, ships, and aircraft. And it needs also the means to make them effective—supplies and a supply system factually responsive to the requirements as well as under command of the responsible authority.

Admiral Noble, Chief of the Navy's Bureau of Ordnance, delivered this address at the Thirty-first Annual Dinner of the A.O.A. held at the Hotel Ambassador, Los Angeles, April 26, 1949.

We and our allies have recently and successfully completed the greatest war in history. That war, as all our other wars, was fought for reasons of national policy by American armies, navies, and air forces which are the armed instruments of that policy.

Based on certain tactical and strategical lessons learned in World War II, we have rearranged our National Military Establishment. Consideration is still being given to further change. However, it is recognized that in any change, it is requisite that if our armed forces are to be adequate instruments of our national policies, they must be effective and flexible.

Much has been said regarding the nature of future warfare. I do not believe it conceivable that the United States will resort to a war policy of mass destruction. I rather believe that we shall hold to our humanitarian principles within a policy which will preserve the maximum of life and property wherever we may have to fight. Such a policy will demand defeat of the enemy armed forces in a war fought by armies, navies, and air forces together. Those forces in the service of the United States must be strong and adequate, each of them. Else we may of necessity find ourselves committed to unacceptable policies or unable to sustain those which are acceptable.

Notwithstanding the dark days with which we have had to contend in the recent past, I feel that we can now discern a ray of light. There is encouraging evidence that our efforts at creating world peace have succeeded at least in reaching a moral balance among nations. Acceptance of the world for what it is and retaining the approach to equalization of offensive and defensive methods gives us a temporary solution affording time to extend our security to other nations.

The United States is now the leader of nations seeking a democratic solution to world problems. We cannot, at our own peril, fail those who have faith in us. We must be patient, we must be right, and we must be strong.

Navy photo

The Navy's Martin AM-1 Mauler can carry three full-size torpedoes, twelve rockets, and four 20-mm. cannon.

Industry Looks at Preparedness

Business Must Increase Its Coöperation with Government

William J. Meinel

I SOMETIMES question the extent to which our business leaders recognize the part that they might take in keeping America strong defensively. To qualify fully in an emergency, one has to know how he or his organization can give complete and effective support to our commanders in the armed forces.

A number of our military chiefs conducted splendid courses in industrial mobilization in an effort to help and guide industrialists in planning their programs for national defense. It would appear that the armed forces have made every reasonable effort to carry out their part of the industrial-mobilization program. It is up to business and industry to recognize what is required of them.

Private industry attracts large numbers of capable engineers and scientists who can contribute much to modernize our defense material, whereas the Government has but a limited number of men qualified to undertake the many new development programs which must be considered.

Some businessmen are easily discouraged by certain business practices of the Government, believing that it is much easier to serve customers other than a Federal agency.

Business Must Coöperate

I have heard businessmen say that they object to a policy whereby the low bidder must agree to the terms of the Vinson Act—redetermination and renegotiation—despite the fact that they had given the Government the most favorable price for the items required by it. There is, of course, some justification for the argument they present. However, businessmen must realize that necessarily there are certain obstacles with which they are going to have to cope. We can and should raise our objections to any needless red tape. On the other hand, we cannot afford to refuse to render adequate service on Government work associated with the strengthening of our defense.

It is understandable that certain companies which have been unusually prosperous might find it to their advantage to spend some of their earnings to aid the Government on research and development work, provided their equipment and personnel are qualified to furnish a special service. Such a policy on the part of industry could pay dividends in the years to come. It would be commendable, indeed, if businessmen would put service to country first, in the same manner and spirit that prompts so many to put country before self and serve their Government as Reserve officers.

Leaders of business have an undeniable responsibility to their Government as well as to their stockholders, to the community in which they are located, and most assuredly to their employees.

Mr. Meinel is president of Heintz Manufacturing Company and also president of the Philadelphia Post of the American Ordnance Association. These remarks were given before a meeting of Ordnance Reserve officers at Frankford Arsenal, Philadelphia, Pa.

"Training our organizations to do business with the Government will permit us to get under way more effectively and quickly in the event of an emergency. We must be prepared to do a gigantic job and to back up and support our fighting men to the very limit of our ability."

Strikes

It may be well to touch on another subject that must have been most embarrassing to our Government as well as to the leaders of our armed forces. This concerns serious strikes during the war years. Strikes during the war in many instances reflected very unfavorably on business management. So often industrialists failed to apply human understanding in dealing with their employees, resulting in harmful work stoppages. This is a matter which needs careful study.

We all realize that strikes in time of war tend to lower the morale of our own soldiers and bolster that of the enemy. We have determined that fully informing employees as to the importance of their work in supporting our fighting forces encourages them to put forth their greatest effort. Leaders in Ordnance have been most coöperative in bringing to the attention of management the value of the industrial contribution. This information, wisely passed along to a group of employees, generally resolves itself in the workers teaming up with management to bring about even greater results.

We have had a number of such experiences, particularly when we were asked to undertake special emergency requirements. On specific occasions a general officer and his staff would come to our plant and acquaint the employees with the significance of their efforts. As a direct result, pressure would be brought to bear on management by the employees to seek the more difficult task since they wanted the thrill that comes as a result of accomplishing the "impossible."

The typical American, it seems, does his best work when he has a challenge to meet or an allegedly insurmountable obstacle to overcome.

Prepare Now

Labor, properly informed, will align itself with management during a war period. I think we are all agreed that strikes during the last war unnecessarily dragged out the months of fighting. Now is the time for business leaders to plan their program for national defense. Training our organizations to do business with the Government will permit us to get under way more effectively and quickly in the event of an emergency. We must be prepared to do a gigantic job and to back up and support our fighting men to the very limit of our ability.

The demonstration of sober enthusiasm here should be an inspiration to industrialists to busy themselves in an effort to do a superior job in the interest of keeping America strong so that we might continue our cherished way of life.

The Red Army

A Searching Analysis of Russian Men and Tactics

Capt. B. H. Liddell Hart

THE Red Army is an embodiment of contrasts. Its strange mingling of new and old, of scientific method and primitive habit, of rigidity and flexibility, is even more marked on the tactical than on the material side. That is logical—for the machines are the product of men and handled by them. The apparent incongruities which baffle casual observers and lead them to widely different conclusions become more understandable and reconcilable when set against the background of the Soviet Army's development.

German soldiers are the only ones in the West who have had experience with or even close observation of the Red Army in action—and they have seen it during successive stages of development under the hardest test. It is to their experience that we must go for any real information about its performance and methods.

Soviet ground forces are a collection of contrasts, embodying the primitive and the mechanized

Two essential points emerge from their accounts: First, the Red Army is two in one—there is an "army of quality" within the "army of quantity," and, although even the former is of curiously mixed quality, it has been developing at a much faster pace than the mass which encloses it.

The other point is that any judgment on the Red Army should be accompanied by the date of its vintage, just as we know the quality of a wine by its year. An expert who has only tasted "Red Army 1941" may be quite misleading about "Red Army 1943," and so on. While the differences of vintage are likely to be less marked since the war ended, it is not safe to assume that the present quality is the same as that of 1945. But a knowledge of certain basic tendencies may be a guide to the question of whether it has improved or otherwise.

Captain Hart is one of Britain's leading military analysts and authors. His latest book is "The German Generals Talk." (Illustrations by courtesy of *Infantry Journal*.)

In examining the wartime record, it is natural to begin with the leadership. When I asked Field Marshal von Rundstedt which were the best generals he met, his verdict was terse: "None were any good in 1941." Rundstedt's chief Russian opponent, on the Southern front, was the famous cavalryman, Marshal S. M. Budenny, one of the legendary heroes of the Russian Civil War. Rundstedt remarked that the aptest description of Budenny was provided by a captured Russian officer who said: "He is a man with an immense moustache but a very small brain."

Budenny had been an imposing member of the "military court" called to sit in judgment on the generals who were arraigned for treason in 1937, and it is clear that this wholesale political purge had very damaging effects on the capacity of the Red Army to meet the test of war. The 1941 invasion showed that incompetence was preponderant in all levels of command.

Better Leadership

But the subsequent *military* purge had better results, opening the way for the rise of talented commanders who could prove their case in the more realistic "trial by battle." The combination of practical testing and wider opportunity produced a remarkable change. By 1942 the level of leadership was rising, and it went on rising year by year while the war lasted.

All the German generals to whom I talked expressed high admiration for the ability of Marshal Zhukov, whom they regarded as outstanding. Next to him they placed Marshal Koniev, praising him as a clever tactician though not regarding him as on Zhukov's level. They considered that quite a number of the other higher commanders had become skilled in the art of maneuvering large forces but that the proportion of able leaders tended to decrease on the lower levels of the high command.

The run of opinion was that the top and bottom of the Russian ladder of command became the strongest sections while the middle piece was shaky. The top rungs were filled by men who had proved themselves so able that they were allowed to exercise their own judgment and could safely insist on doing things in their own way. The bottom rungs were filled by junior officers who, within their limited sphere, tended to develop a good tactical sense, because the incompetent soon became casualties in a field that was ruled by the hard realities of an enemy's bullets and shells. But the intermediate commanders, even more than in most armies, were concerned with other factors. Their superiors' orders and judgments were more to be feared than the enemy.

Elite Troops

Tactically, the best troops were the so-called armored corps—with a level of intelligence among officers and men much above the average. I use the term, "so-called," because in fact the actual armored element was only a small part of the units—they had from 200 to 300 tanks and no other armored vehicles. The composition of these corps varied (here the Russians had a strong sense of flexibility) but was usually either one or two tank brigades, the latter in turn consisting of one tank battalion and some four infantry battalions carried in trucks.

Although the battalions were small by Western standards, the German officers have remarked to me that the Russians profited much in tactical effectiveness by having such handier-sized units. The corps itself was little larger than one of our divisions. In the case of these armored corps there were no divisional headquarters interposed. By cutting out this extra link in the chain of command and letting the corps commander handle direct as many as half a dozen brigades, time was saved and flexibility gained.

The Russian high command rarely placed these armored corps under the control of the ordinary armies but grouped two to six of them in what were called "armored armies" and kept them for special striking rôles. That was wiser than the British habit of putting armored divisions under an infantry commander who is apt to be pedestrianly minded and accustomed to slow-motion warfare. The Russians were careful not only to keep their "army of quality" distinct but also to ensure that it was treated as such.

When the battle front became static after one of the big bounds forward that the Russians periodically made, these armored armies were withdrawn into reserve. There was then usually an interval of several months before the Russians had repaired their communications and brought up supplies, accumulated large stocks of ammunition, and were ready to launch a fresh offensive. The cracking of the enemy's new defense line was left to the ordinary infantry armies, helped by a special reënforcement of artillery and also tank units from the higher command's general reserve.

In a detailed account that was given to me of a typical Russian offensive in the later stages of the war, the methods pursued were made very clear. The assault was delivered by three armies, with some thirty infantry divisions concentrated on a sector twenty-five miles wide, and similar attacks were simultaneously launched on other sectors of the entire front. An armored army was waiting in readiness, its advanced units

Russian infantrymen are able to operate without an elaborate variety of equipment.

standing twelve miles behind the front.

The infantry assault was preceded by a bombardment, lasting for two hours, by some 1,200 guns, and the infantry then pushed forward, eating gradually into the German defensive position. By the third day, after fresh divisions had been put into action, the position was broken through. The armored army moved forward just before the breakthrough had actually been achieved, completed it, and then pushed forward as fast as possible "into the depths" of open country beyond. Similar breakthroughs had been made in other sectors, and the loose-linked chain of exploiting armored armies swept on nearly 300 miles, penetrating successive rear positions where the Germans attempted a stand before the surge was brought to a halt.

High Casualty Rate

The Russian infantry assaults usually suffered heavy losses in achieving their breaching purpose, being planned and executed in battering-ram style. It often happened that assault after assault was shattered by the defenders' fire. On the other hand, the small infantry units often showed skill and cunning in the way they went on, "trickling through" after the formal assault had failed. Thereby they redeemed the failure, and turned the scales.

With shrewd instinct, junior leaders often chose to advance over ground, such as a marsh, that appeared to be a barrier to advance. If a handful of men trickled through in this way in the evening, they might swell to a thousand or more by daylight and the threat frayed the Germans' nerves.

Russian tank tactics also showed a mixture of formality and ingenuity. In 1941 the Russians had tied down their fast tanks to the service of the infantry —the same mistake the French had made to a large extent in 1940. But even when they learned to concentrate their tanks in armored corps and to handle these operationally, they still went back to the "penny packet" method when assaulting an enemy position.

Their tank tactics were cut from a drill pattern, each step carefully planned in advance. For instance, before an attack subordinate commanders were given maps on which individual routes and objectives were marked by colored lines. Such extremely detailed planning suggests that the executants were either not highly intelligent or that it was a policy not to allow much scope for individual judgment and initiative.

Attacks ran much on World War I lines—"tramlines" they might be called —with the tanks closely backed up by the infantry. The assault was delivered by a long chain of mixed packets, with a company of tanks leading a company of infantry. The Russian companies were small, ten tanks or eighty infantrymen, which allowed some degree of local flexibility.

Once the enemy position had been broken through, the tanks would concentrate and continue the advance in a large body until another defensive position was reached. The Russian tank forces became, with experience, skilled in maneuvering in mass during these intermediate stages, but assault methods remained more stereotyped than in other armies.

Their tactical limitations were accentuated by the extreme simplicity of their equipment. The mechanized formations had only two kinds of vehicle —the tank and the truck. They had no reconnaissance machines, staff cars, or motorcycles. If a commander wanted to send a written message or an order, he had to send it in a tank—and that was the more frequent because giving very detailed instructions was unsuitable for radio communication. Late in the war, however, enough American jeeps became available to provide a few for each tank battalion.

The quick support of tanks by infantry elements, and mobile combination between the two, was hindered by the lack of any armored carriers or other cross-country vehicles. That meant waiting until infantry brigades or divisions could be brought up in trucks—and these might be stuck far behind when the sandy roads turned into mud. But the Russians partly filled the gap by mounting infantrymen on the tanks and carrying them forward in that manner until the enemy's fire compelled them to dismount. This was typical of the Russians' way of improvisation to overcome their handicaps.

Forces Poorly Equipped

The mass of the army was much worse equipped. Even the volume of American supplies did not go far in making up the shortage of trucks, and most of them were needed to carry the infantry parts of the armored corps or for the rear services. The ordinary infantry division had to scrape along with a makeshift collection of horse transport—and little of that.

What it meant was vividly explained to me by General von Manteuffel, who led many tank raids behind the Russian front. "The advance of a Russian Army is something that Westerners can't imagine. Behind the tank spearheads rolls on a vast horde, largely mounted on horses. The soldier carries a sack on his back, with dry crusts of bread and raw vegetables collected on the march from the fields and villages. The horses eat the straw from the house roofs—they get very little else. The Russians are accustomed to carry on for as long as three weeks in this primitive way when advancing. You can't stop them, like an ordinary army, by cutting their communications, for you rarely find any supply columns to strike."

The tactical standard of the ordinary divisions was not high, and in many cases rather poor. Their handling, by the commanders, was often unskillful and unimaginative, while reckless of losses. The view of their opponents was expressed in the comment that one of the German army commanders made to me: "The Russians were always very bullheaded in their offensive methods, repeating their attacks again and again. This was due to the way their leaders lived in fear of being considered lacking in determination if they broke off their attacks."

The Germans many times overheard wireless orders that threatened commanders with the direst penalties if they hesitated to launch their troops into a renewed assault—and the troops in their turn were pushed forward with the threat of being shot in the back if they faltered.

Such bullheaded attacks failed far more often than they succeeded, while piling up the losses into millions. But they had a psychological effect on the defender even where they failed. They gave him the feeling that no matter how many waves he shot down, more would come on. That "got him down." It made him more susceptible to the flank threat that arose whenever the Russian armored spearheads pierced some weak point in his extended line.

But it would be a mistake to assume that fear was the main cause of the Russians' amazing fortitude and disregard for losses. There was also fanaticism for the Communistic idea

which Soviet indoctrination had grafted onto a deep-rooted patriotism. And beyond that there was a fatalism natural to the Slav-Asiatic character of the people but given a more automatonlike effect by the new combination of a mechanistic age with a deterministic view of human life.

It is more difficult for an opponent to make an impression on Russian troops, either by shock or surprise, than on those of any other nation. That diminishes his chances of stampeding them by air attack or by a threat to their flanks—to which most armies are acutely sensitive. On the other hand, it gives him more chance of getting right around their flanks before they have realized the danger, and cutting them off—though it may still prove very hard to make them surrender even when their situation is hopeless.

Here we may find the reason why the Germans took such an immense total of prisoners in their great pincer maneuvers yet also had to pay a heavy price themselves, in life and delay, before they could actually put the encircled Russians "in the bag." It is significant that the younger German soldiers who were in the fighting line tend to be even more emphatic in their testimony to Russian toughness than the higher generals who planned these vast encirclements—for it was the former who had to "finish the job." Even so, it was not so hard to force the surrender of such large masses as it was to overcome the small parties that were cut off and surrounded in the course of a battle. These commonly held out until they were all killed or crippled.

Russian Unimpressionability

The "unimpressionability" of the Russians, as well as their exceptional capacity to carry on without proper supplies, needs to be taken into account when considering the claims made for air power as the decisive answer to the Russian threat. There is an influential body of expert opinion in the West, especially in England, which argues that the best way to stop a Russian invasion is to have a great air force ready rather than a big army, and that the former would be a certain way of stopping it—above all by attacking its lines of supply.

Advocating the creation of an allied force of 450 air squadrons, Lord Templewood recently declared that with a "force of this kind I am convinced that the allies could stop and disorganize any attempted advance across the Continent." He was supported by Lords Trenchard and Portal, the two greatest Chiefs of the Air Staff. Their views were based on experience of the Western campaign in 1944-1945.

But such assurance looks dubious in the light of the evidence from the Eastern Front. From this it is clear that the Russians are better able than any Western army to advance in face of a strong opposing air force because of their army's lesser dependence on supply and their troops' greater ability to do without what other armies regard as necessities, as well as the skill they have developed in moving dispersed.

Moreover, when the German Army in France suffered partial paralysis under air attack, the German Air Force had already been driven out of the sky as a result of a prolonged struggle. If the Red Army started to advance and the allied air forces tried to stop it, they would have to reckon on meeting strong interference from the Red Air Force, in the first phase at least—and that would be the vital phase.

Lord Trenchard discounted such interference by arguing that while the Russians might have plenty of machines, and could make good ones, they were inefficient in operating and maintaining them. He went on to declare that the same applied to mechanical vehicles on the ground—"they could not maintain them; and they never have been able to maintain them." That represents a very prevalent view in the West.

Is it a safe assumption? Germans who fought on the Eastern Front say that the Russians had improved greatly in mechanical sense and skill by 1944-1945 compared with 1941. The bigger repairs were not carried out as quickly as in the German Army, but their normal maintenance service was good, and they had plenty of well-trained mechanics. In fact the German tank officers told me that, in the later part of the war, their own maintenance companies were manned almost entirely by Russians, and these proved as good as their own men. From this it seems that we may be in danger of pinning our hopes to an out-of-date idea.

There is a danger, also, in the tendency to dwell on the Red Army as one of quantity without quality, or of uniformly low quality, and to talk as if the problem were that of stopping such a mass-produced army. Trenchard implied this when declaring: "I cannot believe that 500,000, 1,000,000, or even 2,000,000 men could advance without being stopped by the power of the Royal Air Force, backed by the power of the American Air Force."

The Initial Problem

In reality, the initial problem is that of stopping a much smaller but skilled force composed of mechanized spearheads. In the later stages of the Eastern Front campaign it was these fast-moving spearheads which carried out the decisive penetrations, while the mass army walked on behind. It may be more of a problem to stop 200,000 of such troops than to stop 2,000,000 infantrymen.

To meet that problem a large air force is not enough. While a large army with little air support would be an even less safe insurance, there is need for a fair-sized land force of a highly mobile kind to check the Russian spearheads that might infiltrate in the face of air attack. The Western allies are at present far from possessing that minimum insurance on the ground. When it is attained, then it may be wise to put the preponderant effort into developing air strength—to check the mobilized masses of Russia on their long and arduous walk to the West.

Those masses *are* backward in skill and equipment, by Western standards. But the leaven is increasing and rising in both skill and equipment. The post-war disbandment of many divisions and the reduction of the total numbers under arms have made it possible to give a higher scale of modern equipment to those that remain, especially the spearhead divisions.

In brief, Russia's forces present, and represent, a collection of contrasts that confuses the Western observer who tries to place them as a whole in a specific grade. They defy such classification—like Russia itself. So many people ask: "What is the truth about Russia?" The extreme variation of the attempted answers shows the impossibility of a definite one. There was deeper understanding in the man who, from closer experience, replied: "Everything you hear about Russia is true. All the good things you hear are true and all the bad things are true."

Research at CalTech

Military-Scientific Projects at California Institute of Technology

by

Dr. Clark B. Millikan

"Basic research underlies all modern mechanized war"

MANY of the activities of the California Institute of Technology are directly related to the defense program of the country as a whole. In considering this fact it appears that there are four rather distinct types of activity which belong in this category.

. The first is in the classical field of a college; namely, training and education. Here there are three subdivisions which affect the national defense. First, many of our undergraduate and graduate students, when they finish their training, enter industries engaged in defense programs of one sort or another or Government laboratories or research establishments. This is perhaps the greatest contribution of an institution like CalTech to the training portion of its national-defense duties.

Secondly, there are a number of Army, Navy, and Air Force officers who are sent to the Institute for postgraduate training in one or another specialty. Every year the Navy has sent a group of people from the postgraduate school at Annapolis to the aëronautics department of CalTech for postgraduate training. This has been going on for something over fifteen years now, and I was very glad to see recently that two of our first naval-officer students have received their admiral's stripes and the first of our Marine Corps students has received his appointment as a general officer.

Finally, because of a new development which only this year has become possible through legislation, Government laboratories and scientific establishments are now authorized to send civil-service employees on paid leaves of absence to academic institutions for special technical training. I believe we shall have one or two men of this type at the Institute for the first time this year. This is a very wise provision of the Government, and it can be very helpful in fostering the morale and the up-to-dateness of Government establishments.

The second of my four fields of activity may be labeled as Government-supported research in on-campus projects. Such projects employ primarily the regular academic staff and graduate students at the Institute. Some specially hired technical personnel are needed, but primarily projects are manned by the Institute staff and students. Generally the regular Institute facilities are used in these projects, although some large items of equipment are Government-furnished. Most of these projects are very basic in nature, and the activities are, to a very large extent, unclassified. The results are published both in reports to the sponsoring agency and also in the conventional technical journals.

Varied Projects

These projects represent in a very large measure research work on which the staff would wish to be occupied anyhow. In this case the Government agencies make it financially possible for this extremely valuable and fundamental research to be carried on. The fields covered by the thirty-five distinct projects of this type which are now in effect at the California Institute of Technology are extremely wide.

In geology one of the very interesting projects is a study in glaciation and glaciological research in Alaska.

In mathematics there is a project to collect and put into publishable form the prodigious mathematical notes which were left by CalTech's great mathematician, Harry Bateman, on his death in 1946. This task has required the efforts of some six mathematicians from all over the world, who are engaged in a 3-year project of publishing this enormous amount of fundamental mathematical material which Dr. Bateman left unfinished.

Doctor Millikan, director of the Guggenheim Aëronautical Laboratory at the California Institute of Technology, delivered this address at the Industrial Preparedness Luncheon of the Thirty-first Annual Meeting of the A.O.A., Hotel Ambassador, Los Angeles, April 26, 1949.

In physics there are numerous researches on cosmic rays, gamma rays, X-rays, and other problems related to nuclear physics.

Finally, in engineering, there are a number of projects dealing with solids and with liquids. In solids, one of the major studies is the fundamental mechanism of yielding under high local stresses. In liquids, there are a number of programs dealing with cavitation, the fundamental processes of cavitation, and the problem of water entry when objects like torpedoes enter the surface of water. There are also a series of model studies of harbor development, coast erosion, sandbar building, and the like.

Aëronautical Research

In aëronautics—which is strictly a part of engineering but which I am considering separately since it is my own field—there are experimental and theoretical researches on axial compressors and turbines—the type of machine that is so important in the new jet engines. There are structural researches on new types of sandwich construction which make it possible to build extremely light and stiff surfaces for modern high-speed aircraft; studies

of structural stresses and deflections in highly swept back wings, of which almost nothing is known.

In aërodynamics there are, first, supersonic wind tunnel investigations. The first continuously operating supersonic tunnel in the United States was designed and built at the California Institute to serve as the pilot tunnel for the famous Aberdeen supersonic wind tunnel. This first wind tunnel reaches speeds about four times the speed of sound. We now have a project for study and development of another pilot tunnel which is designed to reach still higher speeds.

There are also experimental and theoretical investigations in the fascinating transonic region, which is just in the neighborhood of the speed of sound and which is of such enormous importance in the current development of high-speed aircraft and missiles.

This limited list of examples that I have outlined is only a fraction of the projects which are now in progress, but it shows the wide range of fields and subjects covered. From the titles I am sure you will recognize the very immediate military importance of some. For many others no immediate application is apparent. These are perhaps the most important of all, since if the foundations are not firmly and well laid the applications can never be obtained later when they become vitally important.

I should like to pay tribute at this point to the responsible officers of the Military Establishment who have realized this important truth and to the fact that they have been willing to go so far in the support of fundamental science even though the immediate application to their problems is often not easy to see.

The third type of activity is that of the Jet Propulsion Laboratory, or J.P.L., which is an example of off-campus research. It differs from the projects mentioned above in that it is a Government-owned laboratory located some seven or eight miles from the campus and operated for the Government by CalTech. It is jointly sponsored by several departments of the National Military Establishment, with the Army Ordnance Department carrying much the largest share.

Its task is the carrying out of fundamental researches in the field of jet propulsion, and its product is reports rather than physical articles. It now has extensive and excellent facilities, including chemical, electronic, metallurgical, and several types of engineering laboratories, a number of rocket-motor and test pits, large supersonic wind tunnels, and supporting machine-shop and maintenance facilities.

A technician is placing a guided-missile model in the test section of the supersonic flexible-throat wind tunnel developed by CalTech for Aberdeen Proving Ground.

400 Reports Issued

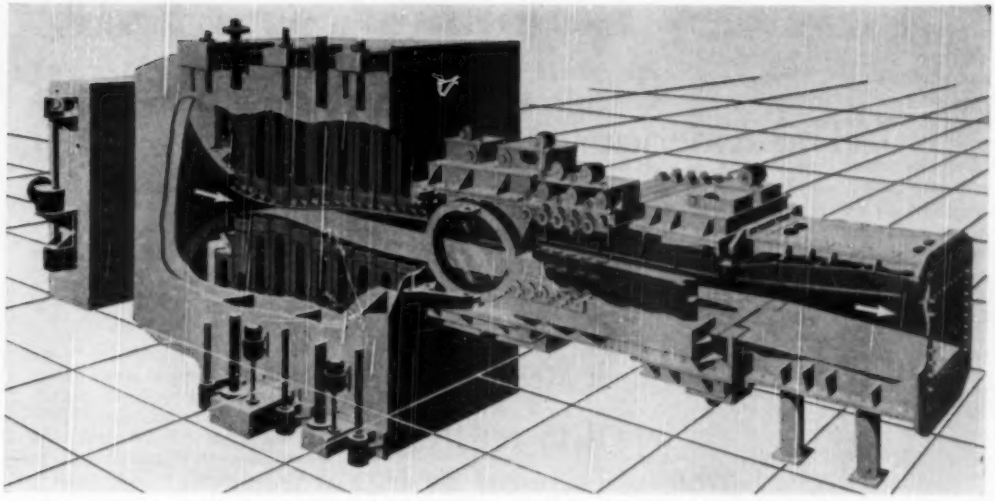
In the approximately ten years since it was established it has issued slightly over 400 official reports and some 50 special publications and releases covering a wide variety of fields, including liquid and solid rocket propellants, combustion, heat transfer, aërodynamics, rocket-motor design and development, thermal jet propulsion, test vehicle design and development, missile guidance and control, instrumentation, etc.

The Jet Propulsion Laboratory's most recent publicized activity was its technical responsibility for the 2-stage sounding rocket which was successfully launched some weeks ago at White Sands Proving Ground. I will only mention the test vehicle used—the V-2 as its first stage and the Jet Propulsion Laboratory's Bumper WAC as the second stage. It was the first high-altitude 2-stage rocket to be successfully operated and reached an altitude of over 250 miles, or something over a million and a quarter feet, far higher than any other man-made device has ever gone.

Of the 500 individuals of the laboratory, several of the leading scientists, in addition to the director, are members of the Institute staff, and divide their time between academic and J.P.L. duties. This assists in the close coördination which exists in many fields between the J.P.L. and the campus laboratories. A considerable number of graduate students take laboratory work and prepare research theses at the laboratory, and the laboratory recruits many of its young engineers from students who have taken the Institute's jet-propulsion course.

It is expected that this coöperation will be further implemented by the establishment next fall of the new Daniel and Florence Guggenheim Jet Propulsion Center on the Institute campus as part of its postgraduate instruction and research program.

The fourth and final type of activity at CalTech, which is closely connected



A diagrammatic view of Aberdeen's CalTech-designed supersonic wind tunnel. Wind speeds up to Mach 4 have been attained.

with the defense effort, is different in nature from the others, and is, I believe, almost unique. It is the Southern California Coöperative Wind Tunnel, which was financed and is owned by a group of five leading aircraft companies: Consolidated-Vultee, Douglas, Lockheed, North American, and McDonnell. It was designed and constructed by members of the Institute staff at a cost of some three million dollars and is operated by the Institute for the owner companies. Practically all the new high-speed aircraft developed recently, or currently under development by these and other companies for the Air Force and Navy Bureau of Aëronautics, have been tested in this tunnel, which can reach speeds up to ten per cent above the velocity of sound.

It has also been used in connection with missile developments sponsored by these and other Government agencies.

Finances

After this brief review of some of CalTech's national-defense activities, I should like to present a few financial figures which will give some idea of the magnitude of its effort in this field. The Institute's current annual operating budget, exclusive of the defense research projects outlined above, is roughly $3,000,000. The on-campus research projects sponsored by the Government now involve annual expenditures of a little over $1,100,000. In other words, over a quarter of the total activities on the campus of the Institute are devoted directly to research for national-defense agencies.

The J.P.L. itself has an annual budget of about three million dollars, and the coöperative wind tunnel is currently operating on a budget of something under a million. Hence the Institute's total national-defense activities are very considerably more extensive than are its purely academic functions. It would, therefore, seem that it was carrying at least its share of the burden of attempting to ensure strength and security for our country in this critical and trying period of international stress and tension.

Although the funds involved seem large from the academic point of view, they are truly negligible in comparison with the country's total defense expenditures. The support of basic research is extremely cheap compared with the furnishing of armies, air forces, and fleets, with their weapons and equipment. Basic research underlies all modern mechanized war, and yet it normally does not appear in the usual military categories of strategic or operational requirements. Its priority in appropriations requests is accordingly apt to be low, in spite of the fact that its value per dollar spent is in the long run extraordinarily large. May I therefore plead for continuing support of this vitally important and relatively inexpensive aspect of the national-defense program.

Industrial Mobilization

J. Carlton Ward, Jr.
Chairman, Fairchild Engine and Aircraft Corporation

The so-called Unification Act of 1947 set up some powerful governmental agencies, not heretofore in existence, which were directly charged with the enormous responsibility of preparing for and being ready for industrial mobilization. Starting with the National Securities Resources Board, an independent agency under a civilian chairman and directly responsible to the President of the United States, we find a powerful Government body in which other Cabinet departments are appropriately represented and which has the primary duty of slicing up the civilian economy into that share which will support armed conflict and that share which is needed to maintain civilian morale and the smooth functioning of the civilian economy in a wartime emergency.

It has been truly said that this Board is one of the most powerful and important of the agencies of our Government. In the less than two years of its existence it has brought many able men from civilian life to Washington, and it has hammered out many principles on which practical planning would have to be built. It is directly responsible for the division of man power as well as materials and services and thus would correlate selective service with essential civilian services.—*Extract from an address before the Wings Club in New York City, April 13, 1949.*

The American Ordnance Association

announces the first junction of

its Thirty-first Year

A Dinner Meeting in honor of

LOUIS JOHNSON

Secretary of Defense of the United States

to be held at 7 o'clock on the evening of

Wednesday, September 21, 1949, at

the Hotel Astor, New York City

¶ Personal invitations with complete details will be mailed to all members in due course. To assure accommodations at this dinner meeting it is suggested that reservations be made without delay.

¶ Members of the Association may bring lady and gentleman guests. Tables of ten. Dress: Tuxedo or uniform, miniature decorations. Reservations, which will be filled in the order of their receipt, will close September 10th. Cover: ten dollars.

Air Force Armament

Industry To Assume Greater Rôle as Procurement and Development Agency

by

Maj. Gen. R. C. Coupland

We must secure the continuous effort of the best scientific and engineering talent and the most capable manufacturers to meet our requirements

AIR Force armament includes atomic and radiological weapons, bacteriological weapons; bombs; guns; guided missiles; rockets; chemical weapons; protective armor; sighting, launching and control systems together with components, accessories, fixtures, handling, training, analyzing and test equipment, and the like necessary to accomplish the Air Force mission.

The traditional method of keeping the art of armament alive during periods of peace is to carry on limited operations and prototype development in Government-owned arsenals. (For any major effort, we realize that we must call upon industry for quantity production.) Even with the relatively simple forms of armament of past years, this system was not wholly satisfactory. With the increasingly complex aircraft systems of the present and future, which embrace nearly all phases of engineering science, use of the Government-owned arsenal facilities appears too costly and too cumbersome for serious consideration.

We recognize that for guns, cannon, and explosive munitions, for which there is no civilian requirement, the development must be closely controlled or be in Government-owned plants. However, the expensive and complicated parts of aircraft-armament systems are not the guns, cannon, bombs, and ammunition—critical as they may be. The hardware—electrical and electronic equipment going into bombing and fire-control equipment, gun mounts and turrets—represents a major part of our program.

Experience has shown several organized sources of scientific engineering development talent. Some of it, of course, is in the military services. Other fruitful sources are such Federal agencies as the National Advisory Committee for Aëronautics and the Bureau of Standards. For basic research, our leading universities and technical institutes constitute a major source.

From a practical point of view, the desirable capability of both development and manufacturing capacity is exemplified in our leading manufacturers of electrical and electronic equipment. Recently, some smaller commercial laboratories have been surveying the aircraft-armament field. Certain nonprofit laboratories are doing exceptional work. Considering all this range of agencies and a certain amount of competition, what is the desirable structure for peacetime development and manufacture of aircraft armament, and how should this peacetime activity be translated to a war effort?

Several Guides

There are several factors to guide us in the choice of agencies. Peacetime contracts for some agencies will greatly enhance their usefulness in war. Then there is the time factor. Certain agencies, large and small, establish the reputation for complex developments under firm time schedules. Others have the capacity to manufacture complex matériel on short notice—at least in small quantities. Other agencies, though they may be more deliberate, establish an enviable reputation for high quality and reliability of their product. Finally, other establishments are organized to produce items in this field with maximum economy. If we were completely free agents, we might make judicious use of these factors in securing a favorable allocation of projects. What can we do and what can industry do in order to achieve the best results?

We are obligated by law and regulations to consider Government-owned sources—first, those in the armed services, and then the other Government agencies in this field. In considering the other armed services, we have two approaches. Sometimes we can use an item that has been completely developed to meet the need of that service. This is an "off-the-shelf" deal. Money and increased procurement are the only considerations. The more difficult case is where an item is required in accordance with Air Force military characteristics to meet planned aircraft development or a strategic concept.

Commercial Contracts

Any project for the Air Force may compete in man power and facilities with the sister service's own projects. Such competition usually results in delaying Air Force plans. Any further expansion to accomplish our projects should be in the Air Force and not in the other services. On a large scale, this is impracticable. If a sister service cannot give the necessary attention to an Air Force project, the obvious answer is to find a nonmilitary agency. Outside of very special developments by the Bureau of Standards, this will involve some kind of a commercial contract with an agency that is able to devote the required skill and facilities to

General Coupland, Director of Armament for the Air Force, delivered this address at the Industrial Preparedness Luncheon of the Thirty-first Annual Meeting, American Ordnance Association, at the Hotel Ambassador, Los Angeles, April 26, 1949.

concentrate on the problem. An effort of this kind gives us the best promise of a timely solution.

Testing under realistic conditions has been a serious difficulty in progressive development. We believe that through the use of facilities now being established at the Air Force Armament Center at Eglin Field, Fla., contractor's testing as well as acceptance and engineering tests will be greatly expedited. The purpose of this center will be to provide a central facility to conduct engineering and development tests of experimental items of armament equipment and to determine the engineering integrity of such equipment prior to release for tactical or operational suitability trials. The center also will conduct examinations, studies, and investigations necessary to arrive at engineering approaches and designs of aircraft-armament systems or components which may be required to meet military characteristics or form the basis of such characteristics.

The combined efforts of science and industry can solve Air Force armament problems.

Detailed plans and regulations for the establishment of the Armament Center are now being formulated. It is expected that this installation will aid greatly in furnishing improved armament of greater reliability at an accelerated rate.

How can we determine the agencies best qualified to produce results of the highest quality and reliability? The engineering staff, the experience of an agency in armament and related fields, and the facilities available are the key to this solution. Continuity of effort in the aircraft-armament field is particularly important. Technical personnel who have qualified on the fire-control and bombing problems are usually not required except for armament development. Unless the staff has continuity of effort on the armament problem, it cannot keep these specialized personnel employed. Since aircraft-armament systems embrace so many components of major diversity, specialization and subcontracting is to be expected.

Concentrating for Quality

This specialization can be emphasized to the point where most of our items would be in the "sole source" category. The judicious application of this concentration would resul in high quality. It may be practicable, in certain specific developments, to follow the successful completion of a development contract with a "sole-source" negotiated production contract. Where the developing agency also has production capacity, a negotiated contract can be justified on both a time and quality basis. An enormous loss of time and many technical difficulties usually result when a different agency gets the production contract.

With the volume of effort required and the need for a broad base to provide for wartime expansion, it is desirable to have at least two agencies in each field that are capable of any specific project. After this consideration of time required, quality, and specialization, it is clear that continuity of effort is of first importance.

The question of how to achieve this continuity by the best qualified agencies within existing law and regulations must be solved because, in this way, we will have the best assurance of over-all economy in our program.

I have indicated some of the considerations in focusing more effective effort on our program. I want to assure you that this effort is necessary.

With a certain stability in aircraft-armament development and manufacturing agencies, we should expect some independent pioneering into new regions in our field. Leadership demands new approaches. I am convinced that, through continuity of support and effort, our leading development agencies should, in the interest of their own reputation and standing, support investigations of new approaches to aircraft armament. With continuing study of strategic concepts and contact with the aircraft industry, these agencies should be able to provide new and profitable directions for our efforts. I have great faith in a free study of the problem.

To summarize, here are our objectives:

(1) To establish a structure of aircraft-armament development and manufacturing agencies of outstanding ability covering the entire range of aircraft armament; (2) to provide continuing support of these agencies in such a manner that our leadership in aircraft armament is assured; and (3) to facilitate development by establishing adequate test facilities.

We hope to make this structure a reality in a matter of months. Members of the American Ordnance Association can help us enormously in this program.

Armament requirements change with every improvement in aircraft design. Thus, the conditions of jet propulsion have created a new set of demands that must be met.

Organization for Defense

The Rôle of the A. O. A. in National Preparedness

Maj. Gen. Everett S. Hughes

General Hughes, Chief of Ordnance, U. S. Army, delivered these remarks during the Ordnance Technology Conference at the Thirty-first Annual Meeting of the A.O.A., held at the Hotel Ambassador, Los Angeles, April 26, 1949.

TIMES have changed since the days of 1916 when Jim Walsh and I together kept the Pershing Punitive Expedition supplied with ordnance! In those days ordnance included saddles, bridles, outfits for mules, meat cans, knives, forks, and spoons. We didn't have any guided missiles in those days, but we had enough headaches as it was.

Times have changed also since those days long ago when we held A.O.A. meetings. At that time, the first "A" stood for "Army," and the meetings were held at the Aberdeen Proving Ground. Those were the days when, due to special dispensation from the Almighty, the A.O.A. meetings were held during the most gorgeous days of October. Those were the days when we all brought our box luncheons, boarded the train, and rode down to the water battery to watch and listen to the 16-inch gun being fired. We were looking backward in those days.

Tonight, here we are gathered in Los Angeles—the Army, Navy, Air Force, and civilian industry—looking forward and not backward. I think it is a milestone in the forward march of national defense in the United States.

I don't think it's necessary for me or anybody else to engage in any of those controversial subjects on which we have seen many headlines in the papers from time to time, such as, "Will the A-bomb stop all wars?", "How long will the next war be?", "Do we need a Marine Corps?", "When will we have bombs that will reach to the moon?", and a few items like that, winding up with, "How is unification coming along?" Right here and now I want to state that, as far as unification is concerned, the Navy Bureau of Ordnance and the Army Ordnance Department were unified long before the Unification Bill was passed!

Ordnance Is Required

The main point of our objective is: If we do have a war, ordnance is going to be required; and if ordnance is required, American industry will have to make it. We hope that American industry will make it fast and furiously. In order to do it, not only must the armed services be organized, but industry must be organized as well.

I want to quote a short extract from an article which appeared in a recent *Saturday Evening Post,* written by Mr. Bernard Baruch, and entitled, "What of the Future?". He says this:

"To reach our allies in time we must know for what we will fight and be prepared to mobilize before the war is begun. Whatever is formed, whatever comes, this trial of our ability to mobilize in advance of war will be the great testing of our civilization. On it will hinge the fate of America and the World. Domestic communists and other fifth columnists will try to paralyze us from acting by exploiting our mutual desire for peace and isolation. But out of those fearful torments will rise modern warfare totalitarian in image, being the extreme opposite of our free individualistic ways. To the extent that we are compelled to mobilize we would have to accept the hateful regimentations and denials which war entails. Because the necessity is to prevent war we must be ready to mobilize during peace. If America's great power is to be used to avert war as well as to win it, we must take our stand before bullets begin to fly."

Therefore it seems to me that the first question for disposal is one of organization. In setting up any organization the first thing to be done is to assign responsibilities and tasks to the people who are being organized. I think, and I have thought this for a long time, that the task assigned to the Army, the Navy, and the Air Force is one, first of all, of seeing that everything possible is done to reduce the load which is to be placed upon American industry when and if war breaks. Provision must be made for the loss of industry which may occur through aërial bombardment. Some provision must be made for increasing the production capacity to make those particular items which every war demands as necessities after hostilities start.

The next thing we have to do is to pay attention to strategic materials and see that we use as few of them as possible in our munitions of war. Then we must translate the military characteristics of weapons which are to be manufactured into drawings and specications which can be read and adopted by and followed by American industry.

Determine Requirements

Then we must determine requirements and make those requirements known to industry through some channel or other, and we must also—and this particularly in time of peace—tie in our current procurement with our industrial mobilization; in other words, use the funds which are appropriated to us by Congress now to the best advantage to see that everything is ready.

That being the assignment to the Army, Navy, and Air Force, the next assignment is to industry itself. I believe that the assignment to industry should consist of one job and one job only, and that is mass production. I am convinced in my own mind that no Navy man or Army man or Air Force man can be a competent mass producer. I know that, as far as the Ordnance Department is concerned, no officer or no civilian who has made ten tanks in

Rock Island Arsenal is a qualified mass-production expert. There is a vast difference between the methods used by industry for mass production and those which we use in our arsenals. Therefore, the assignment of tasks to American industry I might break down into two groups, although there are some others that are complementary.

One is production engineering and the other is mass production. Furthermore, American industry must do what it is supposed to do and not rely upon the military services to do those things for it.

I give you one concrete example, which recently arose in the Ordnance Office, which was the question as to whether or not we would set up in one of our arsenals a line for the production of jewel bearings for watches. In my opinion the Government arsenals should be set aside for doing only those things that American industry cannot do and does not do in time of peace. Therefore, I take the question of the establishment of a production line in an arsenal for the production of jewel bearings as an example of what I mean when I say that American industry should do now what American industry will have to do in time of war.

As far as the organizational setup is concerned, having assigned to the Army, the Navy, the Air Force, and to the Munitions Board their responsibilities in this matter of industrial mobilization, we have then to provide for some means of placing the information we obtain and the data we work out into the hands of the people who are going to have to make ordnance. We have various methods for doing that now. The Navy has its field setup, the Air Force has its field organization, and the Ordnance Department has its fourteen district offices which have been in existence for many years. Through that channel we make known to the field the orders which we have to place, and possible contractors can get their information from our field offices.

Information Needed

But there is other information needed, and that information is more in the nature of help to the services than it is of help to industry. That information comes about in this field of production engineering, and for that purpose the American Ordnance Association has established a large number of technical committees, all composed of very able men, who during World War II were engaged in the manufacture of the items being handled by the committees of which they are members. Those men have given us vast help. I was interested this morning to find how much curiosity the newsmen to whom we talked had regarding the question as to how much help we are getting from those committees. It was very difficult for me to express 100 per cent in any terms except 100 per cent, but as far as the Ordnance Department is concerned, those committees have been of immeasurable help.

"If we do have a war, ordnance is going to be required; and if ordnance is required, American industry will have to make it. We hope that American industry will make it fast and furiously. In order to do it, not only must the armed services be organized, but industry must be organized as well."

A.O.A. Local Posts

There is another channel of command, and I mention this because recently I have been asked repeatedly, where do the A.O.A. Posts enter into this picture? There seems to be a big question as to how and where and when members of these Posts can get into the Ordnance picture. So we have another channel of command. Going back to our Ordnance districts and the location of those Ordnance districts, we find that in the vicinity of any district there is usually an American Ordnance Association Post. Los Angeles, Detroit, all over the country, we have those Posts. Those Posts are able to secure from and give to us all necessary information which is desired by our representatives in the field.

I want to close on one note which I think is very important. I have been away from Washington now about ten days, and at least six times a day since I've been gone I've been given an instance of where some man who produced item "A" during World War II, who has a line set up for the manufacture of item "A" and has all of the know-how to make item "A", has failed to secure an order because somebody has come along and underbid him.

Public Law 413 enacted by a recent Congress lays particular stress on procurement by advertising. It lays particular stress on the necessity for giving orders to small business, but it also provides sixteen or seventeen exceptions to procurement by advertising. It authorizes the Secretary of the Army to place orders with firms in order to promote industrial mobilization, in order to keep a plant alive, in order to provide and place an order with somebody who has the know-how.

Bitter Experiences

But, gentlemen, it doesn't work that way. After all, we have had some bitter experiences, and since business has fallen off, there have been many differences of opinion between possible producers and the Ordnance Department as to how business should be placed. We succeeded not long ago in placing an order with an automotive firm for a vehicle which was so similar to one that we already had that we could place the order on the basis that we had in our storehouses a vast quantity of spare parts which could be used for that particular vehicle. That was provided for as an exception to this Public Law 413.

I cannot emphasize too much the fact that with conditions in industry different than what they were six months ago there is a completely new slant toward the use of Public Law 413. I want to say again that Public Law 413 is a provision by Congress for the promotion of industrial mobilization. It is a legal device by which we can use current money which comes to us for the purpose of keeping industrial lines alive for the purpose of national defense.

We are meeting here in Los Angeles where once again we are combining the Army, the Navy, the Air Force, and the civilian industrialists from most of the United States. We are here with line officers and we are here with staff officers. We are here for the purpose of looking each other over and seeing whether or not this story of national defense and the mobilization for national defense is understood and appreciated. I think it is, and I think that the American Ordnance Association, all of its officers, all of its directors, and most of its members, understand exactly what the great need is, and how to meet that need.

I would like to close with a toast to the A.O.A. and its very fine work!

Thirty-first Annual Meeting

A.O.A. Visits West Coast for First Time

Precedents shattered as Ordnance cohorts gather in Los Angeles and go to sea with the Navy

THE Thirty-first Annual Meeting of the American Ordnance Association held at Los Angeles, Calif., on April 26th and 27th was a precedent-shattering affair. This was the first time that an annual meeting of the Association had been held on the West Coast, and it was also the first time that the Navy had played host to the A.O.A. for its time-honored "Ordnance Day."

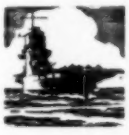
The Hotel Ambassador, luxurious resort establishment located on Los Angeles' fabulous Wilshire Boulevard, was headquarters for the Annual Meeting and the scene of the day-long Industrial Preparedness Session on April 26th. Promptly at 10 a.m. on that day, A.O.A. President James L. Walsh opened the proceedings with a rousing keynote address that sounded the theme—"Working for Peace."

Harvey C. Knowles, vice-president of the Association in charge of National Technical Divisions, who was scheduled to be chairman at the Ordnance Technology Conference which followed, was unfortunately unable to attend due to illness, and Burton O. Lewis, staff consultant to the Association's Divisions, took over the task in grand style and introduced the following:

Illustrated Lectures

Brig. Gen. Philip G. Blackmore, commanding general of White Sands Proving Ground; Rear Adm. W. G. Switzer, commander, U.S. Naval Ordnance Test Station at Inyokern, China Lake, Calif.; and Brig. Gen. William L. Richardson, chief of the Guided Missiles Group, Headquarters, U.S. Air Force. This high-powered trio held spellbound the more than 400 members and guests gathered in the hotel theater with illustrated lectures on rocket and guided-missile development and tests.

Next on the program was the Industrial Preparedness Luncheon. Henry L. Clark, president of the Los Angeles Post of the A.O.A. and official host to the visitors, presided. Mr. Clark and his loyal local committee did a great job in arranging many of the details of the meeting, and all members of the Association are grateful for their unselfish service. Another high-voltage trio of speakers addressed the gathering at luncheon: Herbert A. Gidney, A.O.A. vice-president in charge of local Posts who spoke on this phase of the organization; Maj. Gen. Richard C. Coupland, USAF Director of Armament, whose topic was "Air Force Armament"; and Dr. Clark B. Millikan, director of the Daniel Guggenheim Aëronautical Laboratory at California Institute of Technology, who told of the part that scientific education and research are playing in the national defense. Dr. Millikan was recently appointed chairman of the Research and Development Board's Committee on Guided Missiles.



Following a split-second program, the members went directly from the luncheon room to the hotel entrance where a fleet of deluxe buses, complete with police escort, awaited to whisk them nearly thirty miles through sprawling Los Angeles to the U.S. Naval Shipyard at Terminal Island where Rear Adm. Paul Hendren, commandant, was host at a demonstration of naval technology.

Escorted back again to the Ambassador through the famous L.A. rush-hour traffic, the Ordnanceites just had time to change to black tie and attend a predinner reception to meet the guests of honor. In the receiving line were Gen. J. Lawton Collins, Vice Chief of Staff of the Army; Rear Adm. Albert G. Noble, Chief of the Bureau of Ordnance of the Navy; Maj. Gen. Everett S. Hughes, Chief of Army Ordnance; President Walsh, Mr. Clark, and other notables.

Arranged around the reception room was an exciting exhibit of rockets, guided missiles, and other modern ordnance equipment—so modern in fact that it was protected by a special guard, day and night, while on display. Arrangements for the exhibit were made by Col. W. S. Broberg, chief of the Los Angeles Ordnance District, and the following organizations displayed the various items: Aerojet Engineering Corporation, Bendix Aviation Corporation, California Institute of Technology Jet Propulsion Laboratory, Clayton Manufacturing Company, Douglas Aircraft Company, Harvey Machine Company, Norris Stamping and Manufacturing Company, and Rhodes Lewis Company.

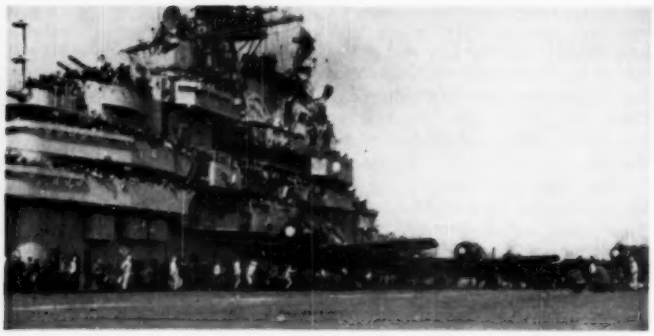
The Annual Dinner

The Thirty-first Annual Dinner was an unqualified success. More than 600 members and guests filled the huge Embassy Room of the Ambassador and stood at attention while the National Anthem was played by an Army orchestra from the local command after Henry Clark had called the gathering to order. Lieut. Comdr. (Chaplain) James D. Hester of the U.S. Naval Receiving Station at Long Beach gave the invocation. President Walsh officiated as toastmaster and introduced the following speakers: General Hughes, Army Ordnance Chief, who praised the rôle of the American Ordnance Association in fostering industrial preparedness for defense; Admiral Noble, Navy Ordnance Chief, who spoke of the importance of sea power as a keeper of peace; and General Collins, Vice Chief of Staff, who told of the need for a well-rounded defense force. These addresses, as well as the others delivered at the Annual Meeting are published elsewhere in this issue of ORDNANCE.

In addition to those who spoke at the day's session, among the guests of honor seated at the head table were: Colonel Broberg; Brig. Gen. Donald L. Putt, Director of Research and Development, U.S. Air Force; Admiral Hendren, the commander of Long Beach Naval Base; William A. Smith, chairman, County of Los Angeles Board of Supervisors; Charles H. Nazro, secre-

(*Continued on p. 40*)

ORDNANCEMEN AT



While A.O.A. members crowd the superstructure, the U.S.S. VALLEY FORGE prepares to launch her F8F fighters. Flight-deck personnel guide the planes into position.

On the way! An F8F "Bearcat" fighter cruise a displacement of 27,000 tons, a flight deck

Members were shown about the escort carrier U.S.S. BAIROKO by ship's officers who pointed out the salient features of this efficient war-proven vessel.

Rear Adm. F. X. McInerney explains the HELENA'S workings to W. J. Boyle of Los Angeles.

Helicopter operations from the VALLEY FORGE were a feature of the cruise.

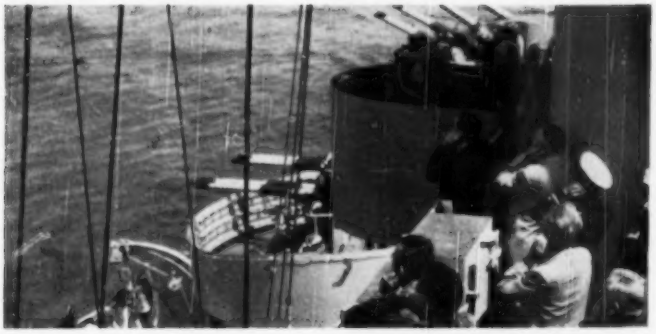
Shutterbugs of the A.O.A. came to the cruise armed with a variety of cameras that ranged from professional-type movie cameras to old-fashioned box Brownies.

EA WITH THE NAVY

the VALLEY FORGE, an ESSEX-class carrier with
feet long, and an extreme beam of 129 feet.

Left to right, D. E. Golden, Capt. H. Farrow, and K. M. Reid aboard the U.S.S. HELENA.

Howard Dyer and Wayne Jenkins were shown about the BAIROKO by Lieut. Comdr. Doherty.



Member guests aboard the U.S.S. HELENA during "Operation A.O.A.," hold their ears against the blast of the cruiser's 5-inch guns engaged in antiaircraft practice.

Left to right, Capt. T. J. Hedding, H. L. Clark, Vice Adm. G. F. Bogan, L. A. Codd, E. Godfrey, and Rear Adm. D. Ketcham aboard the U.S.S. VALLEY FORGE.

Ben McCoy, W. S. Morse, and John Wilks are being shown the operation of the port half of a 40-mm. gun battery mounted beside the flight deck of the VALLEY FORGE.

tary, Los Angeles Post, American Ordnance Association; Maj. Gen. Russell L. Maxwell, New York Post, American Ordnance Association; Earl B. Gilmore, advisory board, American Ordnance Association; Rear Adm. Francis X. McInerney, commander, Cruiser Division Three, U.S. Navy; Henry J. Kaiser, Jr., vice-president, Los Angeles Post, American Ordnance Association; Lieut. Gen. H. A. Craig, Deputy Chief of Staff, Matériel, U.S. Air Force; Henry P. Erwin, treasurer, American Ordnance Association; Vice Adm. G. F. Bogan, commander, First Task Fleet, U.S. Navy; Robert L. Biggers, advisory board, American Ordnance Association; Kenneth T. Norris, director, Los Angeles Post, American Ordnance Association; Maj. Gen. Henry B. Sayler, Assistant Chief of Ordnance, U.S. Army; Fred B. Ortman, president, California Manufacturers Association; Rear Adm. Wilder D. Baker, commandant, 11th Naval District; John Slezak, director, American Ordnance Association; Samuel K. Rindge, treasurer, Los Angeles Post, American Ordnance Association.

The Technical and Scientific Session of the meeting at sea with the Navy on April 27th was a memorable climax to an historic program. This was not only the first time that the Navy had acted as host at the Association's "Ordnance Day," but it also completed the trilogy of "ground, sea, air" begun at the Twenty-ninth Annual Meeting at Aberdeen Proving Ground in 1947 and continued at Selfridge Air Force Base, near Detroit, Mich., last year. It was by far the most interesting and spectacular technical session yet sponsored by the A.O.A., combining as it did demonstrations of ordnance equipment, aircraft, naval surface vessels, and undersea craft.

A.O.A. Goes to Sea

In the gray dawn of April 27th another police-escorted bus convoy left the Hotel Ambassador promptly and traveled to the Long Beach Naval Base where 445 members of the A.O.A. boarded Navy barges and were taken to a waiting fleet of five warships far out in the harbor. These ships were:

U.S.S. VALLEY FORGE, 27,000-ton ESSEX-class carrier, 888 feet long with a beam of 129 feet. Commissioned on November 3, 1946, she carries into practice many of the construction lessons learned the hard way in World War II. In 1947-1948 she made a round-the-world cruise—the first globe-girdling cruise by a major fleet unit since the voyage of the "Great White Fleet." Her peacetime complement of 1,800 men would be increased in time of war to 3,000. Her main turbines of 150,000 horsepower give her a speed in excess of 30 knots. She is the flagship of Admiral Bogan.

U.S.S. BAIROKO, a CVE or escort carrier designed to operate small groups of specialized aircraft against enemy submarines. The BAIROKO is the latest ship of her class, which supersedes the famous "jeep" carrier type.

U.S.S. HELENA, a heavy cruiser mounting a main battery of nine 8-inch rifles and numerous smaller armament particularly formidable against aircraft. This type of vessel is especially valuable in supporting large carrier task forces—a rôle she simulated in the day's exercises.

U.S.S. BRUSH and U.S.S. MADDOX—destroyers which acted as screening vessels for "Operation American Ordnance." Armed with three twin-mount 5-inch dual-purpose guns in the main battery these vessels are capable of putting up a strong antiaircraft defense as well as carrying out their usual rôle of submarine hunters.

The U.S. submarine VOLADOR also participated in the exercises but did not carry any A.O.A. members. Streamlined and equipped with a schnorkel tube for operating her Diesel engines while submerged, she embodies the latest advances in undersea craft.

While the hungry A.O.A. contingent consumed a hearty breakfast in the wardrooms, the task force cleared the L.A. harbor and stood out to sea. The ocean was calm and the sun soon broke through the overcast making perfect weather for the initial demonstration—an antisubmarine exercise. Planes from the BAIROKO soon made contact with the "hostile" VOLADOR and the two destroyers set off to the indicated spot to simulate depth bombing. For the spectators' benefit, however, the sub was "spared" and a short time later scored a direct hit on the VALLEY FORGE with a torpedo (dummy war head). The submarine later demonstrated the use of the schnorkel.

After lunch aboard ship, antiaircraft gunnery practice firing was conducted against several small drone target aircraft which were radio-controlled from another vessel. The little craft dove, looped, rolled, and zoomed with more agility than a full-sized fighter plane, making a very difficult target for the batteries of 20-mm., 40-mm., and even 5-inch AA guns.

An Air Strike

Then came the demonstration that the land-going Ordnanceites had been most anxious to see—a carrier-launched air strike. And it was indeed a thrilling and exciting spectacle for the uninitiate. With speed and precision that belied the difficulties involved, in a very short time more than thirty naval aircraft had been brought up to the flight deck on fast giant elevators from the hangar deck below and were spotted in close formation, nose to tail with wings folded, by the plane handlers who deserve a special accolade for their skill in such hazardous work. When the command to start engines was given, a mighty roar burst from the tethered eagles that made further speech impossible and numbed all the senses as a hurricanelike blast swept down the flight deck from the thousands of unleashed horsepower.

A bit of unscheduled drama was enacted when the engine of the lead plane failed to start promptly and it had to be wheeled onto the outboard elevator by sweating deckmen.

Soon, however, the aircraft were taking off with monotonous regularity—one every twenty seconds. First the F8F-2 Bearcat fighters, followed by the Douglas AD-2 torpedo bombers. Finally, two North American Fury jet fighters were launched by catapult. The two main groups rendezvoused quickly and swept in to attack a spar towed far astern of the VALLEY FORGE. With deadly precision, bullets, rockets, and water-filled bombs churned the sea within a 50-foot circle of the spar as the planes strafed and dive-bombed the target.

The task force then headed for shore with each A.O.A. member deeply impressed by the complexity of modern naval operations and the intricate equipment and high personal skill required to implement naval ordnance. As the sun was setting over the blue Pacific the fleet dropped anchor in Los Angeles Harbor. Operation American Ordnance and the Thirty-first Annual Meeting were over.

Rededication to Peace

Local Posts of the A.O.A. Coöperate With the Fourteen Ordnance Districts

Herbert A. Gidney

It is now proposed that similar coöperation be extended to the district organizations of the Navy and Air Force to ensure full industrial support for our armed forces

IT seems appropriate at this annual meeting of the American Ordnance Association to propose a step for the advancement of the industrial-preparedness program intended to cement the strong bond between the National Military Establishment on the one hand and American industry on the other. This I propose to do briefly at this time.

First, however, permit me to congratulate Henry L. Clark, the able president of the Los Angeles Post of our Association, who has done such effective work in the advancement of the Ordnance cause and whose tireless efforts have contributed so much to the success of this Thirty-first Annual Meeting.

From the start, Mr. Clark has been tireless in planning this meeting and in making possible many of its features which have already proved so attractive. He has been assisted by a group of Ordnance stalwarts who aided him at every turn and who, too, deserve a great share of our thanks and congratulations for what has been accomplished and what is going to be done as a result of this historic meeting in the delightful environment of Southern California.

With such fine teamwork and effective coöperation of the naval officers who participated in this important industrial meeting, and of the interested businessmen here, it is bound to be worth while. Our cause is peace, maintained through proper understanding and practical means. As some of you know, I have been closely identified with the American Ordnance Association since its very beginning. I mention this simply to emphasize the sustained interest which all of us associated in this endeavor to keep America strong have had throughout this long period in an effort to strengthen our national defense by strengthening the bond between the National Military Establishment and American science and industry.

Guiding Principles

Permit me to recall some of the principles that have governed our Association from the very first hour of its formation at the great Aberdeen Proving Ground on the shores of Chesapeake Bay, Md., in October 1919. At that time industrial preparedness was a new science. It had been born amidst the emergency of World War I.

Under the guidance of Maj. Gen. William Crozier and his successor, Maj. Gen. C. C. Williams, industry and Ordnance formed a team which was to endure throughout the following twenty-two years of peace, and under the leadership of Maj. Gen. C. M. Wesson and Lieut. Gen. L. H. Campbell, Jr., Chiefs of Ordnance of the Army in World War II, was to prove itself one of the greatest adjuncts to victory in that conflict.

So close were the original concepts of the Industry-Ordnance Team in those days that the organization of the A.O.A. closely parallels the organization of the Army Ordnance Department itself. A.O.A. Posts were set up quickly in those cities where Ordnance districts had their headquarters, so that within a relatively few years wherever there was an Ordnance district there was also its copartner Post of the Association.

The present policy provides that local chapters of a Post can be formed wherever there is a need in local manufacturing and educational communities, and such chapters carry on their activities under the sponsorship of the parent Post. You see we are interested in education as well as in manufacture. As time goes on additional Posts will be formed wherever warranted.

The Ordnance districts and the A.O.A. Posts complement each other in an ideal way. When the Ordnance district needs the support of science and industry its approach is through the Ordnance district organization whereby, with a minimum of effort, the competent leadership of industry, as represented by the officers, directors, and other members of the local A.O.A. Post, is available for every assistance. In many useful ways we may be said to be the voice and vehicle of the armed forces.

To confirm my recollection of this point I had occasion recently to examine some of the old files of ORDNANCE magazine, and I found that even in the first issue, our distinguished president, Colonel Walsh, who is the dynamo, I might say, of our organization and who was the founder and first editor of our magazine, published a chart showing the

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Colonel Gidney, vice-president in charge of local Posts of the American Ordnance Association and executive vice-president of Gulf Oil Corporation, delivered these remarks during the Industrial Preparedness Luncheon of the Thirty-first Annual Meeting of the A.O.A., held at the Hotel Ambassador, Los Angeles, April 26, 1949.

parallel organization of the Army Ordnance Districts and the Ordnance Association Posts, which from that day to the end of World War II was the standard pattern of operation of the Industry-Ordnance Team.

Prompt Mobilization Achieved

It has been said by leaders of Ordnance, who have every reason to know whereof they speak, that this unofficial relationship, having no other purpose than the advancement of the national defense of the United States, was in a large measure responsible for the prompt mobilization of industry in World War II to such an extent that as much as six months' time was gained through these means. And time is money and men.

At the rate the terrible conflict sacrificed the lives of our young men and women and spent the wealth of our Nation it is not difficult to form some idea of what six months of time gained in effective mobilization really meant to the security of our country then and now. This close relationship between A.O.A. Posts and Ordnance districts also assisted on many other levels of coöperative endeavor. The officers of the Association have always maintained a close, cordial contact with their opposite files in the National Military Establishment.

In the days when the first mobilization plan, which antidated World War II by ten years, was in formation, the officers of the Ordnance Association were in constant contact with Assistant Secretaries of the Army and the Navy and the heads of the other planning branches, giving such counsel and advice as they were qualified to offer through experience in peace and in war. Throughout all these years the Association has conducted its operations as a nonpolitical, noncommercial organization, with no thought of self-interest or of individual or group advancement, and labored wholeheartedly to keep America strong for peace.

Unity of Planning

In a word, patriotism and the flag and unity of planning have been our only ideal for achieving peace through preparedness. We are strong-hearted men, and are still confident through community of spirit and practical effort we can prevent the tragedy of a third World War. This, then, is the proposal which I would like to contribute on this historic occasion: That the same spirit of coöperation and unity which existed so long and to such good purpose with the Ordnance districts be extended now to the district organizations of the Navy and of the Air Force, as well as the Army. Through this means the local organizations in the American Ordnance Association can render the same sort of patriotic service, not only to the Army Ordnance district system, but to the district procurement offices of the Air Force and to the inspectors of ordnance in the various naval districts.

"The Army Ordnance districts, the Navy districts, and the Air Force districts—or whatever form of organization of the armed forces is made effective—on the one hand and the strong, united American Ordnance Association on the other, concerned with all matters connected with armament, with ordnance design, production, and supply, is a team which will without fail keep America strong."

The Grass-Roots Level

In making this proposal I take for granted that the district organizations of the three services, having proved their worth many times throughout the years, are to be continued in coördinated effort. It would be a tragic thing if their organizations were weakened. They have the great advantage of spreading the knowledge and service at the grass-roots level, where the physical activities take place, and thus bring together across the conference table the men who know the matériel that must be produced and the many related services that must be rendered.

It is on that level that the real technical production and logistic problems are solved. Therefore, the closer the bond of union between industrial leaders and the individual executive officers of the districts in the three defense services, which are well on their way in uniting in common defense of our country, the closer we come to the real working team which in time of war is worth its weight in gold.

I will not weary you by describing the detailed procedures by which such teamwork can be effected. It would not be difficult either of description or of operation. This much I am certain is true: If we are to keep America strong, as indeed we must, for adequate ordnance production in time of war, then one of the strongest links will be forged by close personal contact and acquaintance between the men in industry who must coöperate in the design and manufacture of ordnance and the men of government who must see that adequate quantities of ordnance of modern design are made available when and where needed by our armed forces.

Personal Tie

It is on this personal tie that much depends in our everyday industrial progress, and upon the same tie the success of our ordnance program will depend. Therefore I would like to give you as one of the major potential contributions of this Thirty-first Annual Meeting of our Association a rededication to the time-proven principles of the industry-ordnance teamwork, through the Ordnance district system of the armed forces, share and share alike—the Army, Navy, Air Force, and all the related national activities in the National Military Establishment.

We of the American Ordnance Association are pledged to that type of close coöperation on a broad, coördinated basis. Just as in World War I we brought together the Army Ordnance districts and the local Posts of our Association, so will we be wise if we develop and broaden that philosophy here and now to include also the same local organizations of the Navy and of the Air Force. We invite all the interested scientists, industrialists, and other patriotic citizens who believe in this teamwork to join in the work of the Association.

A Strong America

The Army Ordnance districts, the Navy districts, and the Air Force districts—or whatever form of organization of the armed forces is made effective—on the one hand and the strong, united American Ordnance Association on the other, concerned with all matters connected with armament, with ordnance design, production, and supply, is a team which will without fail keep America strong.

Outline of Guided Missiles

by

Brig. Gen. W. L. Richardson

We Must Maintain Our Position In Applying Science to Warfare

"Within the coming decade many of our present types of guns and bombs will be replaced by guided missiles"

THE official definition of a guided missile is: "An unmanned vehicle moving above the earth's surface, whose trajectory or flight path is capable of being altered by a mechanism within the vehicle."

The first recorded work on guided missiles, in the modern sense, was a project established in 1917. Under the guidance of General Motors' research genius, Charles F. ("Boss") Kettering, the Air Service of the U. S. Army experimented with a flying bomb, utilizing a small biplane with a 38-horsepower engine. By 1924 radio remote control was applied and hits were scored on several targets, one of which was ninety miles away. During World War II, this technique was applied to worn-out bombers, which could then be utilized as guided missiles.

The recent expansion of guided-missile development was initiated by the Germans in World War II. The Nazis, experts in mass psychology, put a large amount of effort behind their "vengeance" weapon development, with particular priority going to the now famous V-1 "buzz bomb" and the V-2 rocket. It is interesting to note that both of these weapons were intended for use against area targets, particularly London. Meanwhile, the weapons intended for field application against our armed forces—such as the controlled bomb *Fritz X*, the fighter-carried X-4 antibomber rocket and surface-launched air-defense missiles like *Wasserfall* and *Schmetterling*—were given less emphasis and failed to influence the outcome of the war.

The American philosophy was the opposite of the German. Believing that we could win the war with conventional weapons, only a comparatively minor effort was placed on guided missiles. The missiles chosen for development were intended for special use. Azon, a vertical bomb with control in azimuth, was developed for attacking long, narrow targets which were not well defended. The obvious use was against bridges, and combat results, especially in the China-Burma-India theater, were gratifying. Various types of glide bombs and glide torpedoes were developed and used in operations with not too much success. In another instance, war-weary B-17's were loaded with 20,000 pounds of explosives and flown by radio control against the submarine pens in Europe.

When the war ended, this country had nothing that could compare with the extensive German guided-missile establishment. Our leaders had exercised proper judgment by emphasizing conventional weapons over such unproven devices as guided missiles. However, technology had advanced to the stage where development of new and useful guided missiles was feasible and necessary if the United States was to continue to maintain its position in the application of science to warfare.

Brig. Gen. W. L. Richardson

Missions of the USAF

The three prime missions of the USAF are: (1) The conduct of strategic air warfare; (2) The air defense of the United States; and (3) The support of the other services. The postwar guided-missile program has been designed to provide the Air Force with superior weapons with which to accomplish these missions. Military characteristics for these weapons have been formulated to serve as goals toward which research and development should strive; *i.e.*, the planners and operational people have stated what these new missiles should be able to do. Now the scientists and engineers are working to meet these performance objectives.

The most difficult problem is to attain high accuracy, and much effort has been and is being expended to solve this problem. There are still many advances to be made in the fields of aërodynamics and propulsion, but, in general, it is agreed that, given a satisfactory guidance system, the design and development of a vehicle would be almost routine.

There are two general types of guided missiles available to us today. The first of these is the ballistic rocket with a flight path very similar in shape to that of a basketball when a player is trying for a goal. Thrust is applied only during a short initial period after which the rocket coasts to the top of its trajectory and then is pulled back to the earth by gravity. Disadvantages of this type missile are its limited range and

General Richardson, chief, Guided Missiles Group, U. S. Air Force, delivered these remarks at the Ordnance Technology Conference, Thirty-first Annual Meeting of the A.O.A., at the Hotel Ambassador in Los Angeles, Calif., on April 26, 1949.

the difficulty of achieving accuracy. Advantages include its short time of flight and its tremendous speed and altitude. Defense against this type of missile is very difficult.

The second general type of missile is the air-breathing missile, so called because the oxygen used for fuel combustion in the engine is drawn from the earth's atmosphere, whereas the rocket carries its own oxidant. The air-breathing missile must travel in the atmosphere somewhere below 100,000 feet. It must be provided with wings for lift and can employ aërodynamic surfaces for control. Disadvantages of the air-breather arise from its being limited in altitude, thereby being more susceptible to defensive measures and being limited in velocity due to aërodynamic drag. However, the two main advantages are much more important. First, it is capable of much longer ranges, and secondly, the guidance and control problems are not so difficult as with the rocket.

Development of guided missiles for the Air Force is being handled by the same methods employed for conventional aircraft development. Industry is invited to participate in research and development as well as later production. Generally, the aircraft companies and the electronic manufacturers are primarily concerned. Other members of the industrial family are invited to develop and manufacture components. Educational institutions are called upon to perform basic research and to assist in the fields of mathematics, physics, and other pure sciences. Government agencies monitor the research and development projects and assist in test flights, while also engaging in some applied research.

The successful development of guided missiles from conception of the requirement to the finished operational item requires a large number of varied and specialized facilities. Each contractor requires certain basic facilities extending from electronic testing equipment to large static test stands. The Air Matériel Command has aërodynamic and propulsion research and development facilities, mostly at Wright-Patterson Air Force Base, Dayton, Ohio. Its electronic research and development is handled both at Dayton and at the Watson Laboratories in New Jersey. Guided-missile flight-test facilities at short ranges are available at Holloman Air Force Base, Alamogordo, N. Mex. Testing of developed missiles under operational conditions will be done in the interim at Eglin Air Force Base, Fla., at the Air Proving Ground.

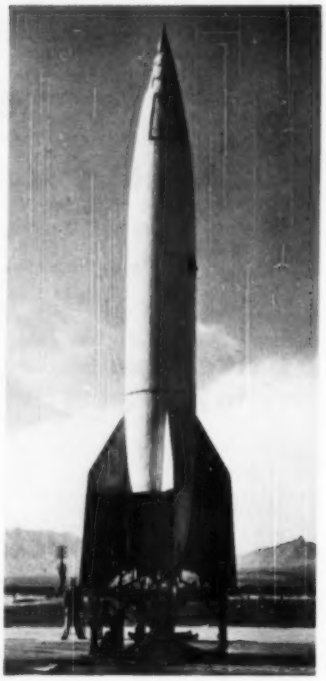
New Proving Ground

The new Joint Long-Range Proving Ground is intended for use both in research and development and in the operational testing of long-range missiles. At present the maximum distance available for firing guided missiles at the combined White Sands-Holloman Air Force Base range in New Mexico is a little over one hundred miles. Trying to test a 3,000-mile missile there is similar to batting out baseball flies in your living room. We have asked Congress to authorize the construction of a long-range proving ground for the joint use of all three services.

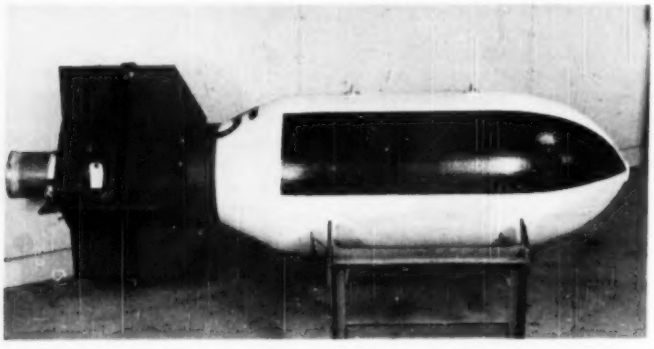
In a program as large and complex as the guided-missile program of the National Military Establishment, it is necessary to go to considerable lengths to avoid undesirable duplication and make efficient use of the funds and personnel available. Coördination throughout the services is largely effected by the Guided Missiles Committee of the Research and Development Board. The Board reports directly to the Secretary of Defense and therefore carries a big stick. The Air Force, Army, and Navy are represented on the Guided Missiles Committee, along with prominent civilian authorities.

The committee, through its panels and working groups, continually monitors all phases of research and development on guided missiles. The committee also provides a medium for the working members of the services—in the presence of qualified civilians—to thrash out their differences.

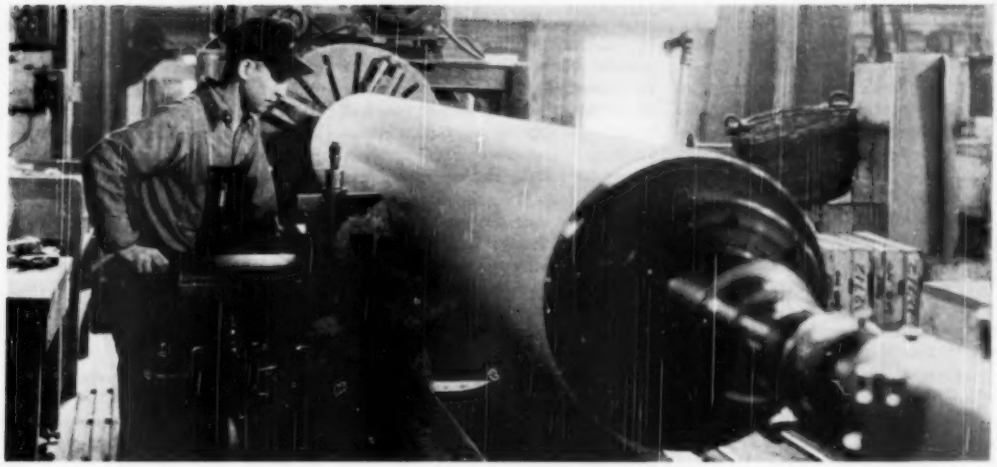
The future of guided missiles looks very promising. Scientific and technical strides made in the past ten years have advanced us to the threshold of a guided-missile era. It is anticipated that within the coming decade many of our present types of guns and bombs will be replaced by guided missiles, and that surface-to-surface missiles will have important applications in the field of strategic and tactical bombardment.



German leadership in the guided-missiles field at the end of World War II, as evidenced by the V-2 rocket, was undisputed.



The Azon bomb, with azimuth control, was used for attacking long, narrow targets.



Diamonds in Industry

They Are One of the Foremost Strategic Materials

by

Roger F. Waindle

"Three-quarters of all the diamonds produced in the world today are used industrially"

DIAMONDS have become so important to industry—and particularly to American industry—that it behooves all of us to know more about them. The reason for the industrial importance of the diamond is simply its excessive hardness—a hardness far beyond any other known material, whether natural or manufactured. Some misconception on comparative hardness of hard materials has been common to most of us because prior to 1939 developments in hardness-testing equipment did not allow even fairly accurate hardness classification of hard materials in arithmetical relation.

Until that time the mineral scale, popularly known as the Mohs scale, classified *natural* materials on the basis of their scratch resistance and arbitrarily assigned a number denoting relative scratch resistance. For instance, no material is hard enough to scratch diamond, so it was assigned number 10; corundum (sapphire) could be scratched by diamond, but by no other material known in 1818 when that system was established, so it was designated as number 9 in hardness; topaz became 8, quartz 7, etc.

The fallacy in the Mohs system becomes apparent when it is seen that, by lately developed Bureau of Standards equipment, the diamond has at least *three times* the hardness of the next comparable hard material. The close numerical relation between numbers 9 and 10 in the Mohs scale led to the oft-repeated but misleading statement that a material harder, or in the hardness range of sapphire, was "almost as hard as diamond." It is apparent that no material is almost as hard as the diamond.

Long Used as Tools

Diamonds seem to appear early in industrial applications in connection with timekeeping devices where they were used as bearings. As tools they appear in Chinese antiquity, and as early as 1805 Sir John Barton's ruling

ORDNANCE is indeed fortunate to have from one of the outstanding authorities on industrial diamonds an article on this subject for its readers, particularly since industrial diamonds are playing an increasingly important rôle in production.

The author, Roger F. Waindle, is general manager of the Industrial Production Division of the Elgin National Watch Company, engaged in the development of new products, methods of manufacture, and marketing of sapphire and diamond abrasives.

During World War II Mr. Waindle was chief of the production section, Tank-Automotive Branch, Chicago Ordnance District. Mr. Waindle also served on subcommittees of the American Gage Design Committee, A.S.T.E., and as representative to the A.S.M.E.-S.A.E.-sponsored American Standards Association Committee on Surface Finishes. He has acted as adviser to the Bureau of Standards' Diamond Powder Standard Activities and is chairman of his local chapter of the A.S.T.E.

The author has written for many technical magazines on the industrial sapphire, surface finishing, and diamond abrasives and has addressed many technical groups throughout the country on these subjects. He is highly qualified to write about industrial diamonds.

E. B. GALLAHER, *Chairman, A.O.A. Abrasives Committee*

engine employed them for engraving work. Both sapphire and diamond were used in turning operations where a very high finish was desired; again, in the manufacture of watches and navigating chronometers. However, the industrial use of diamond in tool operations did not progress very rapidly until development of synthetic grinding abrasives in bonded grinding wheels about the turn of this century demanded diamonds as the most efficient substance for truing these abrasive wheels.

However, single-point diamond tools, such as lathe and boring tools, wheel-dressing tools, or stone-cutting saws required only the highest quality industrial diamond, particularly suited to such work either because of its natural crystalline form or because of its lack of crystalline form (many diamonds verge on being amorphous) in which form they are generally conceded to be tougher. This meant that South African, or Congo industrial diamonds, the most prevalent of all, had almost no market. Then came the tungsten carbides.

Carbide tools have worked production miracles. But carbide itself must be worked or shaped. In the production of a carbide tool the material is pre-shaped while "green" or unfired and while it is soft. However, fine contours and final finishing must always be done on the final, hardened tool—and this has been found to be best accomplished by the diamond. Accordingly, the technology developed in the bonding and forming of synthetic grinding wheels of the usual silicon-carbide and aluminum-oxide type was applied to diamond, resulting in similar grinding wheels where the hard diamond now did the work.

The large expansion in the use of hard carbide tools has resulted in a corresponding growth in the use of diamond grinding wheels which are generally provided with crushed diamond of the Congo variety. This large field for a variety of diamond not considered generally useful only ten years ago has already led to such a tight supply situation that diamond purchasers are being forced to accept a quantity of higher priced tool stones with every purchase of crushing boart!

Diamond "Fines"

It is interesting to note further that the last item of diamond occurring on the market at low prices because of its large availability was diamond "fines"—sizes below those popularly consumed in diamond grinding wheels. In the past few years, scientific application of fine diamond abrasive to the finishing of carbide tools for longer life and better work-piece finishes and for micro-finishing metal surfaces resulting in longer life has opened up such a tremendous demand for this versatile hard material that even this form of the diamond is no longer a surplus item.

Industrial diamond usage has become so widespread in this country that an active technical association of producers and users of diamonds has been formed in the Industrial Diamond Association of America, Inc. Its object is to assist industry better to understand the diamond as a tool and use it most efficiently in our mechanized machine age. Technical bodies such as the American Society of Mechanical Engineers, the American Society of Tool Engineers, and similar organizations which have done so much to further the manufacturing development of this country now include the diamond in their agenda and technical publications. The industrial diamond has come of age!

To become more specific, let us look at some of the more important uses of industrial diamonds. The two items today consuming the largest quantity of diamonds are the dressing or truing of tools and diamond-bonded grinding wheels. Every manufacturer now uses grinders in machining metals. Today these grinders are often automatic, hopper-fed, and they grind to tolerances considered laboratory curiosities only ten years ago. Such machines have automatic truing attachments equipped with single- or multiple-point diamond tools.

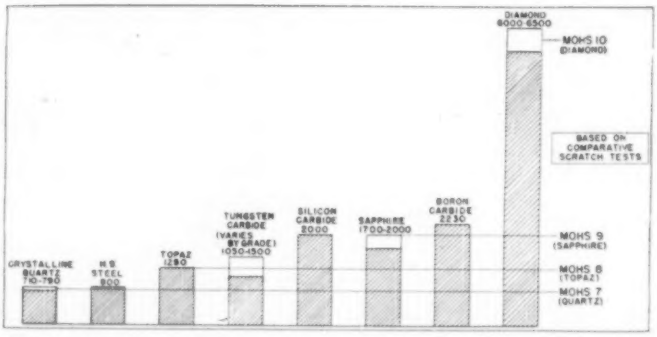
Precision thread grinding, a comparative newcomer among commercial processes, is possible only because diamond tool producers and machine-tool manufacturers have coöperated concurrently to produce diamond tools for the job. In this operation the diamond tool makes it possible to transfer onto the grinding wheel specified forms, angles, and radii with accuracy as close as one ten-thousandth of an inch (.0001″). Since these forms can then be ground into hardened materials from the solid without any preforming, high production, cost savings, and accuracy are all attained simultaneously.

While it is necessary to true all grinding wheels, even those for offhand grinding, so that the grinding operation may be true and even, it is also necessary that abrasive wheels be cleaned periodically because the pores between the grains become loaded with cuttings and the abrasive is dulled; this is corrected by diamond dressing.

Use In Grinding Wheels

By far the largest consumer of diamonds is the diamond grinding wheel consisting of sized particles of crushed diamond held by metallic, resinoid, or vitreous bond or body. As was stated before, the growth of this product parallels the growth in the use of hard carbide tools. Of course, the progress in diamond-wheel development has resulted in its adoption for many other operations such as glass cutting and the fabrication of jewel bearings for watches and precision instruments.

Incidentally, diamond wheels cannot be trued or dressed with a diamond tool. Silicon carbide sticks and wheels perform this operation neither efficiently nor accurately, but they are conceded



This chart, based on Bureau of Standards tests with the Knoop indentor, shows the relative hardness of diamonds, and shows the inaccuracy of the Mohs system of classification.

to be the best means available. It is unfortunate that the use of diamond wheels for precision, semiautomatic, or contour work is limited because of the inadequacy of any other material for truing.

The three types of bonds commonly used for diamond wheels are selected for the application. For instance, the metal bond is preferred for grinding sapphire, glass, and quartz; the resinoid is most popular for carbide grinding where it apparently gives a high production rate either wet or dry; vitrified wheels are newer and are generally finding their place in specific applications between resinoid and metal bond. These preferences are general, however, as in our own plant we have in certain instances adopted resinoid-bond wheels for sapphire cutting. It will be found that the characteristics of peculiar service requirements will determine the proper bond to use.

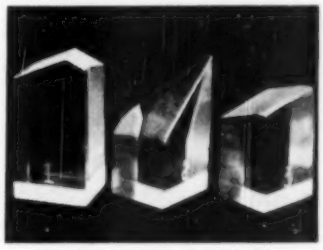
The "painless" dentist becomes a reality with diamond drills which cut so rapidly and efficiently that pain-causing heat generation is reduced and patient comfort becomes a reality; diamond drills cut holes in glass picture frames; diamond core drills have been used for mining operations since the 1870's. Lately developed core drills are drilling deeper, cheaper oil wells throughout the world.

Wire-drawing dies of diamond have been used since early 1800's. Today carbide dies are growing in use, but for fine work or on wire sizes roughly under 1/16-inch diameter, diamond is still the standard. Most diamond dies are drilled by a newly developed electric-spark method that has so reduced drilling time that, in spite of greatly increased diamond cost, diamond drawing dies are still priced as cheaply as prewar.

Huge diamond saws cut quarry building stone; smaller saws cut and shape glass, quartz, sapphire, ruby, etc. Glass cutting with diamonds dates back to the fourteenth century.

Turning and boring tools of diamond can machine hard rubber, fiber, plastics, nonferrous metals, porcelain, and stone. In general, the diamond machine cutting tool is used for cutting materials too abrasive for other tools or where exceptionally high finishes are desired. The diamond is monocrystalline and can be polished to such a superfine finish that it imparts this same finish to the work piece. Such finishes are very often quite important for service characteristics of finished parts. For instance, aluminum automotive pistons are now almost always turned with diamond tools, while the piston pin holes can now be so accurately bored to such a high finish that the steel pin can be fitted directly to the piston without the bronze bushings formerly employed.

Diamond tools complement the carbides in many uses. For instance, carbide is most generally used for rough-turning electric-motor commutators, but the finish cut, requiring the utmost in



These are plastic models of diamond tools designed to be used in turning operations.

tool wear resistance and commutator surface finish in the order of 8 to 10 mu r.m.s., requires diamond tools.

It is suggested that a review of the use of industrial diamond in the manufacture of fine watches will illustrate the many uses for diamond tools in industry. The experience of this industry may again point the way for other industries in new tooling developments since it is an historical fact that almost every basic tool and precision machine had its origin or development within the watch and clock industry. For instance, Elgin Watch developed the first compound subpress die, the key to interchangeable parts from the punch press and gave to industry the spring-type collet chuck without which the automatic screw machine would lack much of its usefulness. For a look into the diamond-tool future, therefore, we may look at our current use of diamonds in watch manufacturing.

Of the approximately 150 different pieces in a watch movement, over 40 per cent are processed with diamond! Here attainment of finer products, made to smaller and smaller tolerances while reducing manufacturing costs through operation elimination, has been accomplished at least partially through diamond tools. Properly shaped diamond tools cut through the oxide layers on the metal surface of the work piece producing superfine finishes to close tolerances completely free from easily worn amorphous metal so that such parts wear longer and give better service.

Other Uses of Diamond

Automatic screw machines use diamond tools for forming the heads of balance screws. Here continuous service up to six months without resharpening has been recorded. Manufacture of the balance wheel from blank to finished product involves eight diamond-tool operations requiring that many distinct tool designs.

Damaskeening, or mechanical decorative finishes, are performed with specially shaped diamond tools, and mirror finishing of bevels and chamfers, opening of small holes, and slotting and engraving operations are all performed by diamond which has drastically reduced tool replacement down time.

The sapphire and ruby jewel bearings of the watch are manufactured completely with diamond.

The production of minute parts to very close tolerance and finish limits requires the most precise tools. Punch and die sets, work holders, cutting tools, and even machine sleeve bearings are finished with loose diamond abrasives. Such abrasives, for instance, have recently been released to industry in general with the result that higher finishes, closer tolerances, and longer wear at surprisingly low cost are being made available to all.

Fully three quarters of all the diamonds produced in the world today are used industrially. The lack of diamond tools was a severe handicap to German production toward the end of World War II. Today industrial diamond is one of the foremost strategic materials and is high on the priority list in the stock-piling program. Concerning the availability of artificial diamonds the answer is still "no" and prospects are not bright for synthesis of this material. Ninety per cent of industrial diamond comes from one mine area where extraction technology leaves lots of room for improvement. Currently, steps are being taken to modernize for large production; foreseeable diamond supply promises to be sufficient at least for the next ten to twenty years.

Honorary Student Members

Associate Standing Awarded Engineering College Groups

THE Chicago Post of the American Ordnance Association recently helped to inaugurate a new A.O.A. policy of honoring selected students of engineering colleges by enrolling them as associate members of the Association in recognition of their qualities of scholarship, patriotism, and leadership.

At the Palmer House in Chicago, with Rear Adm. Albert G. Noble, Chief of the Navy Bureau of Ordnance, as guest of honor, twenty-five students each from the University of Illinois, Illinois Institute of Technology, and Northwestern University were enrolled as associate members of the Association and publicly presented with membership scrolls by James L. Walsh, president of the A.O.A.

The Chicago Post's Student Activities Committee consists of the following: William Ryer Wright, chairman; John Slezak, Post president; H. J. Prebensen, M. J. Allen, J. W. Karraker, William G. Swartchild, Jr., G. D. Dearlove, G. R. Catlett, E. J. O'Keefe.

Faculty counselors for the various groups are: L. F. Audrieth, H. H. Jordan, and Edwin D. Luke, University of Illinois; J. T. Rettaliata and LeVan Griffis, Illinois Institute of Technology; George C. Lamb, Burgess H. Jennings, and J. F. Calvert, Northwestern University.

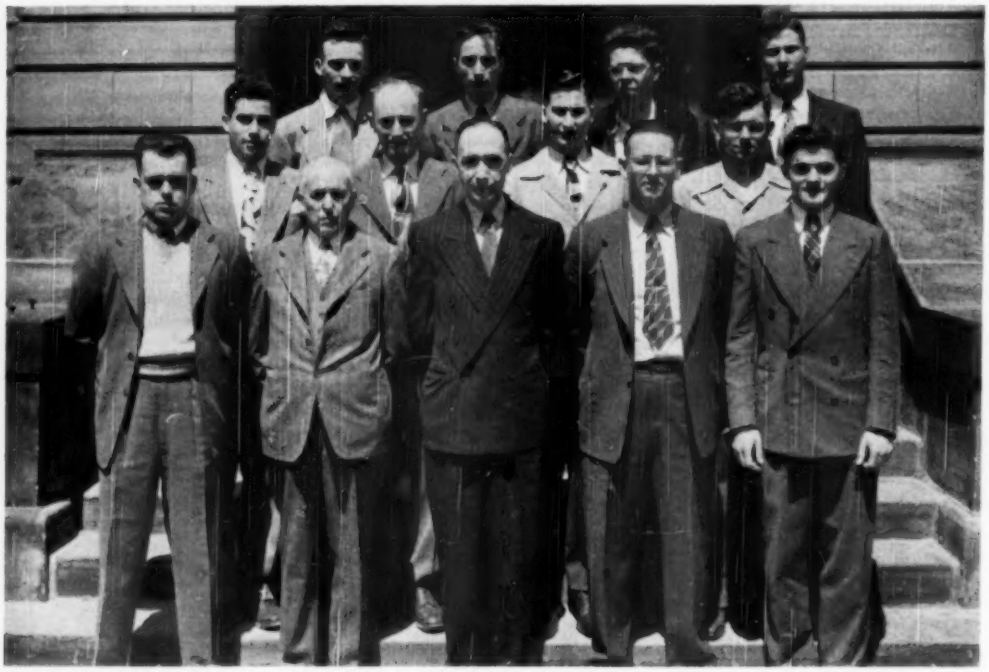
According to the recently adopted program for student members, at each recognized engineering school located within the territory of a Post there will be selected each year by the faculty from the junior and senior classes a number of male students to be nominated as candidates for membership in the Association as associate members. These names will then be submitted to the secretary of the local Post together with a condensed statement regarding each man and his special qualifications.

The man must be a good student, patriotic, and possess leadership. Metallurgical, mechanical, electrical, and chemical engineering students will be preferred, although others will be equally eligible if the faculty selects them.

The students so nominated will be passed on by the A.O.A. Student Membership Committee of the local Post. If elected, they will receive in due course a formal notice of their election from the secretary at national headquarters.

This election is a high honor bestowed by joint action and selection of faculty and alumni members of the local Post.

Student members thus nominated and elected do not pay dues until one year after graduation when they will become eligible for regular membership



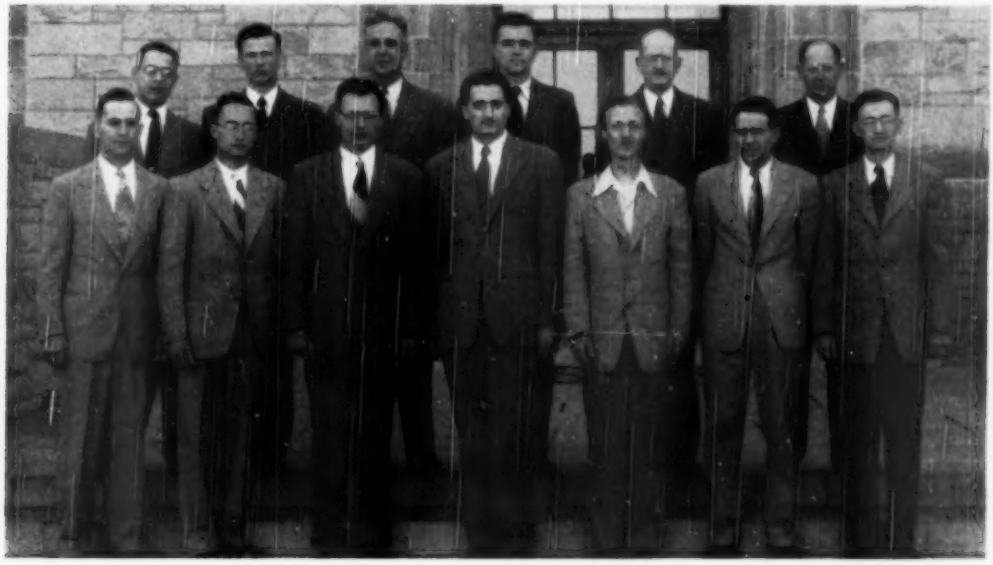
University of Illinois A.O.A. group (left to right): Front row—Mr. Byers; Profs. H. H. Jordan, L. F. Audrieth, and E. D. Luke; Mr. Reinsch; Second row—Messrs. Jacobson, Novak, Barthel, Benjamin; Third row—Messrs. Bower, Peterson, Wentworth, Turner. The following members are not in the photo: W. C. Bennewitz, G. R. Caskey, Jr., J. T. Funckes, R. C. Gardner, W. E. Henderson, J. J. Parry, Jr., R. L. Pontious, R. H. Reber, E. F. Searight, W. C. Wiley, H. N. Brown.

Illinois Institute of Technology A.O.A. group (left to right): Front row—D. H. Ward, M. L. Grimshaw, E. R. Stanley, J. C. Hamilton, R. H. Baldwin, T. J. Walsh, R. F. Domagala, L. J. Speicher; Second row—J. V. Peterson, E. S. Fajnor, W. P. Comis, D. D. Pasik, G. L. Bowman, E. A. Zietz, L. C. Hardison, Prof. LeVan Griffis, J. P. Tansey. The following are not on the photo: R. W. Amstutz, L. L. Czyzewski, D. F. Leal, H. R. Zeitlin, J. T. Rettaliata, dean of the engineering division, and J. P. Makielski, administrative assistant.

and will then pay the customary dues.

Counselors are members who are alumni of the schools to which they are assigned and are appointed because of their special interest in the undergraduates of their college. The personnel of Student Member Committees is thus selected from regular members well known to the respective college faculties.

Counselors perform a very worthy and self-satisfying dual function: they work in close coöperation with their respective schools and with honor students thereof.



Northwestern University A.O.A. group (left to right): Front row—I. J. Sitar, J. B. Naines, Jr., D. J. Siwy, B. Bulovic, F. G. Fender, W. M. Whisler, P. E. Beam, Jr.; Second row—C. R. Norlander, C. H. Fox, Prof. G. G. Lamb, K. E. Weaver, Prof. J. F. Calvert, Prof. B. H. Jennings. The following members are not on the photograph: T. K. Breitfuss, H. N. Cantrell, E. Cohler, E. T. Harley, E. W. Larson, Jr., R. B. McFarland, K. R. Merckx, T. C. Meyer, G. V. Michael, L. J. O'Brien.

Month by Month: A Review of the National Defense Situation

DEFENSE STREAMLINING

The Senate Armed Services Committee approved legislation converting the National Military Establishment into a full-fledged executive Department of Defense, and relegating the Departments of the Army, Navy, and Air Force from the status of executive departments to that of military departments.

The bill conferred vastly increased powers on the Secretary of Defense, trimmed the powers of the service Secretaries sharply, established the post of Chairman of the Joint Chiefs of Staff, and provided stronger financial controls over military budgeting.

Basically, the bill makes no change in the philosophy underlying the Administration bill submitted to Congress by the late Defense Secretary, James Forrestal.

The measure establishes the Defense Secretary as a Cabinet official with full control of his Department, and specifies that he shall have full control over the three service Secretaries. It would abolish the newly created post of Under Secretary of Defense by changing it to Deputy Secretary of Defense. The Deputy Secretary would outrank the three service Secretaries.

A major change in the new bill, as compared with the Administration measure, concerns the post of Chairman of the Joint Chiefs. Under the new bill, the Chairman would head the Joint Chiefs, take precedence over all other officers of the armed services, and receive the highest pay and allowances authorized, but he would have no vote among the Joint Chiefs and could exercise no military command over them or over the services.

The Tydings bill also changes the relationship between the Defense Secretary and the Munitions Board, as well as the Research and Development Board, by placing them directly under the control of the Defense Secretary.

In line with recommendations of the Hoover Commission, the Office of Comptroller of Defense would be created in the Office of the Secretary of Defense.

JAMES FORRESTAL

The highest tribute we can pay to the late Secretary of Defense is to remember, cherish, and practice the philosophy of life that characterized his distinguished public service. At the Twenty-ninth Annual Dinner Meeting of the American Ordnance Association two years ago, Mr. Forrestal had this to say: "We have no desire to conquer the persons or the property of other people nor any desire to control their ideas and their thoughts. We think of human beings all over the world, toiling upward painfully and slowly toward the light of greater freedom and greater well-being, not as a vast amorphous mass of faceless men but as a collection of individuals, each carrying in his soul and in his heart the light of God's grace, entitled to be considered as a human entity and not as a mobile item on an anthill."

Rarely have our American philosophy and faith been stated so simply and unequivocally. Mr. Forrestal hated tyranny in any form. He was as much opposed to war as to unilateral disarmament. In all things he sought the middle way, the reasonable and fair solution. He thus took his stand on the side of Aristotle, St. Thomas Aquinas, and the other architects of our Western culture in defending the integrity of intelligence and the sacredness of human personality.

The Association mourns the passing of a great national leader, a genuinely civilized man in a barbarian age, a servant of the principle of unity and brotherhood that embraced but also transcended the unification of our armed services.

ATLANTIC ARMS PROGRAM

It is estimated that about 40 per cent of the $1,130,000,000 North Atlantic arms-aid program will represent the value of surplus American equipment to be transferred to European nations.

The rest, or about $678,000,000, is the actual monetary cost in dollars, rather than in kind, of the program for the first year. This is expected to be expended for the manufacture of new arms and equipment and for raw materials to be converted by European factories into arms.

The estimated full cost of the program, however, involves a bookkeeping transaction. The 40 per cent, or $452,000,000, representing the value of transferred American surplus, has been arrived at by valuing this equipment at about ten cents on the original dollar cost. Thus, North Atlantic Pact countries will be given equipment, now valued at $452,000,000, which, when new, cost our Government about $4,520,000,000.

This procedure has sometimes been followed in the past in transfers of surpluses to other countries, notably to China, and since much of the equipment to be transferred is obsolescent, and in some cases obsolete by postwar American standards (though still useful), the ten per cent valuation is believed to be a realistic one.

One of the problems ultimately to be resolved will be the replacement of equipment thus transferred from American stocks. Secretary of Defense Johnson is understood to have urged that at least some of the equipment to be transferred to Europe ultimately be replaced to provide our forces with reserve stock piles.

This would appear to be mandatory. At the same time, if all equipment were to be replaced, the ultimate replacement cost would be far higher than the original dollar cost of $4,520,000,000 because the purchasing power of the dollar has shrunk and new items are more complex.

MILITARY ECONOMY

A plan to put national-defense expenditures on a firm budgetary and fiscal management basis, leading to a possible saving of 1.5 billion dollars a year, has been laid before Congress.

It is aimed at coupling economy with efficiency and at orienting military outlays with national-security needs and economic capacities. It was presented and explained to the Senate Armed Services Committee by Ferdinand Eberstadt, a member of the Hoover Commission on Organization of the Executive Branch of the Government.

Featured in the plan is a new "performance budget" that would reflect clearly the cost of functions and activities that could be identified readily as self-contained, integrated operations. Through such budgets, it was contended, Congress and the public could become better informed on the character and relative importance of functions and services. The emphasis now is largely on budgetary calls for personal services, supplies, and equipment.

The "performance budget," it was also argued, would permit the President, Congress, and the public to determine the efficiency and economy with which programs had been executed.

Mr. Eberstadt told the committee that former President Hoover, Bernard M. Baruch, and Secretary of Defense Johnson had approved the plan.

GUIDED MISSILE RANGE

President Truman signed a bill on May 11th which authorized the Air Force to begin construction of a 3,000-mile range for testing guided missiles and providing $75,000,000 to get it started.

The ultimate cost has been estimated at $200,000,000. The exact location of the range has not been disclosed, but military authorities have said it will be to the south to take advantage of good weather conditions all year round.

Present proving grounds of the armed forces can handle missiles of 100-mile range. The Air Force has announced that it will be ready to test 500-mile weapons this year.

The new range will extend over the sea and will have observation stations at regular intervals.

AIR RESEARCH PROGRAM

Advanced aviation research facilities developed in foreign countries constitute a mounting threat to American military and civilian supremacy in the air, Congress was told by the Air Force and the Civil Aëronautics Board.

Air Force Secretary W. Stuart Symington and CAB Chairman Joseph J. O'Connell told Congressional committees that American aviation currently is paramount both in the fields of performance by experimental aircraft and in quantity and types of operating airplanes.

However, they warned that this is not sufficient answer for the future.

Mr. Symington told the committee that Air Force pilots have flown "hundreds of miles per hour beyond the speed of sound," which is measured at 760 miles an hour at sea level under medium temperature conditions. He indicated that further research in speedy planes was badly needed, and he urged Congress to authorize quickly a $311,000,000 fund for this work.

In addition to new and expanded Air Force facilities, eleven million dollars would be spent on thirteen new transonic or supersonic wind tunnels. Mr. Symington pointed out that the new wind tunnels would be only comparable to and not superior to German wind tunnels of ten years ago. He did not reveal why the Air Force needed so many air tunnels immediately, and how he arrived at the number thirteen is not clear.

Mr. O'Connell said that, while the United States is doing no production work on advanced types of civil transport planes, important developments were progressing in Great Britain, France, Russia, "and other countries." He cited particularly a jet transport already produced by the British.

Meanwhile, the National Advisory Committee for Aëronautics announced that the American aircraft manufacturing industry, without the benefit of thirteen wind tunnels, could go into almost immediate production of supersonic planes capable of combat in the event of a war emergency.

Present supersonic planes are strictly experimental or laboratory models. They are not practical combat planes and never were meant to be. From them aëronautical engineers have learned enough to build a successful combat plane that could outstrip the speed of sound.

At Langley Air Force Base, Va., a new supersonic wind tunnel is in operation where an air flow 2.2 times the speed of sound has been achieved. Engineers can study the action of exact wing and fuselage models at what would be speeds of more than 1,600 miles an hour.

HARRY DIAMOND HONORED

The Harry Diamond Ordnance Laboratory was formally dedicated at the National Bureau of Standards in Washington on May 6th to the memory of one of the Nation's foremost scientists and inventors whose contributions saved countless lives in World War II.

Mr. Diamond, who died last year at the age of 48, had pioneered in the development for American and allied use of "blind landing" flying aids, the radiosonde for forecasting weather from the upper atmosphere, and the radio proximity fuze that exploded upon electronic contact with its target.

The new laboratory, a modern red-brick building, was built in 1945. A brief ceremony on the site, marking the dedication and the unveiling of a plaque, brought tributes to Mr. Diamond from Dr. Edward U. Condon, director of the Bureau of Standards; Charles Sawyer, Secretary of Commerce; and the Ordnance Chiefs of the Army, Navy, and Air Force.

In a surprise announcement, Dr. Condon disclosed that funds were available, from voluntary contributions by friends and associates of the late inventor, to establish an annual Harry Diamond Award in the fields of electronic physics and engineering to be made by the Institute of Radio Engineers.

PEACETIME ROCKET INDUSTRY

A peacetime rocket industry rivaling the present aircraft industry in size and importance is sure to come in this country, Dr. G. Edward Pendray, rocket adviser to the Daniel and Florence Guggenheim Foundation, predicted recently. Recounting the story of rocket development in the United States, where in the last twenty-five years rockets have passed through "all their stages from a fantastic idea into a multimillion dollar guided-missile program," Dr. Pendray declared that the next stage would be the development of peacetime uses for rockets "of a type that will put the rocket industry on a paying basis and pave the way for industry-sponsored research that will open up uses for rockets and jet propulsion undreamed of at present."

Among the nonmilitary uses for rockets projected by Dr. Pendray are high-altitude rockets for weather forecasting, aërial mapping, searches and exploration, and rockets for high-altitude scientific research on cosmic rays, upper-air radiations, and astronomical observations. These will be followed, he predicted, by automatically controlled rocket-driven craft for carrying mail and express over long distances at speeds above 5,000 miles an hour and eventually by passenger-carrying rockets.

MINE DETECTORS AVAILABLE

In response to numerous requests, surplus mine detectors will be sold to local law-enforcement agencies for use in searching for criminal evidence, the Army Signal Corps announced recently. Occasionally, they have been loaned in emergencies. Buried firearms, for example, can be located with such equipment.

Approximately 3,000 mine detectors of a type designated AN/PRS-1 were declared obsolete this year and consequently surplus to Signal Corps needs. This electronic device will detect not only metal but any foreign substance buried or otherwise hidden from sight.

Association Affairs

NOT SINCE THE AMERICAN ORDNANCE ASSOCIATION was founded at Aberdeen Proving Ground, Md., in October 1919, has there been a more active period than the past quarter-year. The Ordnance flame—on land, sea, and in the air—has taken on new brilliance the country over. As reported elsewhere in this issue, the Thirty-first Annual Meeting at Los Angeles established new records in April.

But preceding and following it from coast to coast there has been an upsurge of activity among local Posts to indicate the renewed loyalty of members to the Ordnance cause. At meetings, seminars, conferences, and demonstrations there have been opportunities to study the pressing problems of the Science-Industry-Ordnance Team. Here is a swift swing around the circle.

• **MARCH 23RD THE CHICAGO POST** at the Palmer House, Chicago, was host to Rear Adm. Albert G. Noble, Chief of the Bureau of Ordnance, United States Navy. Seventy-five honor students —twenty-five each from Illinois Institute of Technology, University of Illinois, and Northwestern University Technological Institute—were enrolled as student members and publicly presented membership scrolls. The presentations were made by James L. Walsh, president of the Association. The Post's committee on student activities consists of William R. Wright, chairman; John Slezak, H. J. Prebensen, M. J. Allen, J. W. Karraker, William G. Swartchild, Jr., G. D. Dearlove, G. R. Catlett, and E. J. O'Keefe.

At an afternoon conference Brig. Gen. J. K. Christmas, of the Logistics Division, Army General Staff, addressed a well-attended seminar on industrial mobilization.

• **MARCH 24TH THE MILWAUKEE POST** at Hotel Pfister.—A stock pile of ordnance "know-how" was the urgent plea of James L. Walsh, president of the American Ordnance Association, at the annual dinner of the Post. Nearly 200 members and guests representing all phases of science and industry in the Milwaukee area were in attendance. Col. Frederick D. Hansen, president of the Post, presided at the meeting.

Colonel Walsh pointed out that the American total of 313,000 killed in World War II was heavy, but still only one-fifth of the Germans and Japanese killed. This result was due to the superior American machines and equipment with which the fighting forces of the United States and a great portion of the United Nations were equipped.

Other speakers on the program were Burton O. Lewis, staff consultant of the Association and assistant to Harvey C. Knowles, A.O.A. vice-president in charge of Technical Committees and Divisions; and Leo A. Codd, executive vice-president of the Association.

The committee in charge of the meeting under the chairmanship of Colonel Hansen consisted of the other officers and directors of the Milwaukee Post: Vice-President N. R. Knox; Directors F. R. Bacon, P. H. Batten, L. R. Clausen, W. W. Coleman, J. E. DeLong, H. S. Falk, G. H. Fobian, Walter Geist, F. D. Hansen, H. S. Johnson, Jr., H. V. Kohler, J. C. Merwin, R. A. Uihlein, P. J. E. Wood; and Secretary-Treasurer Jacobus Kruyne.

• **MARCH 30TH, THE WASHINGTON POST** at the Mayflower Hotel, Washington, D. C., honored Donald C. Carpenter whose outstanding work as Chairman of the Munitions Board has resulted in marked progress throughout the field of industrial preparedness. He gave some startling figures on the importance of military supply in modern warfare. In the Franco-Prussian War (July to September 1870) five per cent of all money expenditures of the combatants was spent on military supplies. In World War I (1914-1918) thirty per cent of the expenditures of the United States was for supplies, while in World War II (1939-1945) the percentage of expenditures for military supplies rose to seventy-five per cent.

Equally startling were figures cited by Mr. Carpenter as to the per-capita cost of destroying an enemy soldier. This cost through the years has grown from the days of Julius Caesar when it was 75 cents; Thirty Years' War, $50; the American Civil War, $5,000; World War I, $25,000; to World War II when it reached $125,000!

At a subsequent meeting of the Post on May 23rd Admiral Noble was the guest of honor and the following officers were elected for the coming year: President, Alfred H. Hobelmann; first vice-president, Brig. Gen. John K. Christmas; second vice-president, A. Wilbur Mace; secretary-treasurer, J. Donald Browne; directors: Robert L. Eichberg, E. B. Erickson, F. W. Foster Gleason, Howard L. Jennings, Ludlow King, C. E. Meissner, Col. W. G. Lockwood, Arthur L. Milk, Lewis M. Parsons, Col. Philip Schwartz, Stanley A. Shank, and R. P. Williams; advisory board: Maj. Gen. C. T. Harris, Jr., Brig. Gen. S. E. Reimel, Prof. Arthur F. Macconochie, Brig. Gen. Earle McFarland.

• **APRIL 6TH, THE HARTFORD-SPRINGFIELD POST** at Hotel Kimball, Springfield, Mass., honored Edward B. Gallaher. More than 250 members and guests of the Hartford-Springfield Post of the Association met for this annual dinner meeting of the Post. Mr. Gallaher, well-known author of the American Ordnance Letter for the past 2½ years, was honored for his outstanding work in support of the Association and was presented with an Ordnance plaque as a permanent indication of appreciation. Mr. Gallaher then addressed the meeting on "The America of Tomorrow."

Rear Adm. Albert G. Noble, Chief of the Bureau of Ordnance of the Navy, presented a very interesting talk on the work of his Bureau.

Leo A. Codd, executive vice-president of the American Ordnance Association, introduced Mr. Gallaher and told of his unselfish and untiring efforts in founding and writing the American Ordnance Letter. He praised Mr. Gallaher's work and thanked him in behalf of the national organization. Stanley C. Hope, president of the Hartford-Springfield Post, acted as toastmaster of the meeting.

A delegation from the Yankee Post attended the meeting and joined with the Hartford-Springfield members in recognition of the founder of the American Ordnance Letter.

• **ON APRIL 21ST AT KEOKUK, IOWA,** the Quad Cities-Iowa Post held a dinner meeting which was also attended by members of the Keokuk Chamber of Commerce. Col. W. W. Warner, commanding officer of Rock Island Arsenal, was the main speaker. He outlined the activities of the arsenal and gave reasons why manufacturers should become interested in the research, development, and industrial work presently being done there. The secretary of the Quad Cities-

Iowa Post, Donald L. Myers, also addressed the meeting.

T. E. Stahl, president of the Quad Cities-Iowa Post, also attended this meeting as did Fred C. Glass, production chief of Rock Island Arsenal, who contributed available data relative to the arsenal shops.

In May the following Post officials were chosen in a ballot election: President, George A. Uhlmeyer; vice-president, Karl E. Madden; secretary-treasurer, Donald L. Myers; directors, Laurence A. Murphy, N. L. Etten, Clay E. Murray, William L. Voss, Samuel G. Rose, John H. Ploehn, C. D. Wiman, T. E. Stahl (retiring president), G. L. Weissenburger, L. M. Gildea, C. A. Waldmann, E. W. Ross.

• **ON APRIL 21ST (SAN JACINTO DAY)** the annual meeting of the Texas Post was held at the San Jacinto Inn located on the San Jacinto Battleground within the shadows of the San Jacinto monument which towers 570 feet into the sky. Activities included a luncheon at the Shamrock Hotel, a tour of the Houston Ship Channel, a visit to the Battleship Texas, and a dinner meeting at which the following were elected for the coming term: Herman Brien, president; Dan J. Martin, vice-president; and S. P. Farish, director. Mr. Wittlinger, as the retiring president, will also serve as a director.

• **ON APRIL 22ND AT ANN ARBOR, MICH.**, the University of Michigan Post directed an exhibit for the Engineering College Open House. The exhibit consisted of a display of ordnance optical instruments and peacetime products of the optical industry. The theme of the display was the conversion of industry to war production in time of emergency. Argus, Inc., of Ann Arbor, Mich., made this display possible by lending the Post many of its products.

At the annual election of officers the following were chosen for the coming year: Robert E. Legate, president; Duane C. Sherman, vice-president; Donald P. Kelly, Jr., secretary-treasurer; Theodore W. Daykin, corresponding secretary.

• **ON MAY 6TH AT COATESVILLE, PA.**, the Aberdeen Proving Ground Post enjoyed a plant trip to the Lukens Steel Company. With the representatives of the A.O.A. was the 2402nd Research and Development Group of Aberdeen. The Lukens Steel Company is an integrated organization containing open-hearth, platemill, gas-cutting, fabrication, and weldment facilities. The tour through the plant was conducted by competent guides, and all the members had the opportunity of viewing the many stages in the complete fabrication of steel equipment.

All members of the Post joined in congratulating Col. Leslie E. Simon who was recently awarded the Shewhart Medal by the American Society for Quality Control. Colonel Simon, director of the Ballistic Research Laboratories at Aberdeen Proving Ground, is a pioneer in the field of statistical methods of quality control. He was largely responsible for the spread of quality control throughout the National Military Establishment during the war and in many industrial endeavors as well.

CAMPBELL MEDAL AWARDED

Two outstanding Industry-Ordnance leaders were honored by the American Ordnance Association on May 10, 1949, when, in the presence of a brilliant assembly of members of the Michigan Post at the Hotel Statler, Detroit, the Campbell Gold Medal for Distinguished Service was founded and its first award made. Lieut. Gen. Levin H. Campbell, Jr., Chief of Ordnance, United States Army, 1942-1946, in tribute to whom the medal has been named, was present at the meeting and personally bestowed the medal upon its first recipient, K. T. Keller, who served as a special adviser to General Campbell during the second World War.

Mr. Keller is a director of the American Ordnance Association and president of the Chrysler Corporation. Announcement of the founding of the medal in honor of General Campbell and of its award to Mr. Keller was made at the meeting by James L. Walsh, president of the Association. The citation which accompanied the award to Mr. Keller reads:

"The American Ordnance Gold Medal, founded in honor of Lieut. Gen. Levin H. Campbell, Jr., Chief of Ordnance of the United States Army, 1942-1946, is awarded by the American Ordnance Association to

K. T. KELLER

Production Adviser to the Chief of Ordnance, United States Army, during the second World War.

"For distinguished service in the design and quantity production of superior ordnance for the armed forces of the United States—ground, sea, and air. With inspiring leadership he marshaled scientific, engineering, and industrial strength for certain victory in war; with penetrating vision and constant zeal he has sustained the active peacetime program of the American Ordnance Association for the advancement of national preparedness. Production engineer, industrial statesman, humanitarian, and patriot, Mr. Keller is acclaimed by the American Ordnance Association for his tireless efforts for the security of our country by providing the tools to protect American lives and to enforce peace."

• **ON MAY 10TH AT HOTEL STATLER, DETROIT**, when the Campbell Gold Medal for distinguished Ordnance service was presented to Mr. K. T. Keller (see box) the following officers and directors of the Michigan Post were elected for the coming year: President, Charles T. Fisher, Jr.; first vice-president, Harvey C. Fruehauf; second vice-president, S. E. Skinner; secretary-treasurer, Lester R. Downie; directors, H. W. Alden, Robert P. Briggs, M. E. Coyle, George T. Christopher, Joseph M. Dodge, Mr. Fisher, Benson M. Ford, Mr. Fruehauf, Mr. Keller, George W. Kennedy, George D. Mason, Mr. Skinner, S. T. Stackpole, Oscar Webber, and Herbert J. Woodall.

• **AT PHILADELPHIA ON MAY 11TH** a meeting was held of the Philadelphia Post which, from the standpoint of attendance and about everything else, was the most successful since the "Ordnance for Victory" meeting held in 1945.

More than 400 persons attended the entire program, beginning with a tour of the Budd Company's Red Lion railway car plant, at Bustleton, outside Philadelphia. The tour, which was made in groups of fifteen, required an hour and a half.

Following the tour, guests were taken by buses of the Philadelphia Transit Company to the Huntington Valley Country Club where the meeting was held. The huge terrace of the club had been canvas-covered and a public address system installed.

The meeting was conducted by the retiring president, William J. Meinel, president of Heintz Manufacturing Company, assisted by Albert W. Gilmer who is heading up the reactivation of the Ordnance Reserve Officers' group in the district. The speakers were: James L. Walsh, president, American Ordnance Association; L. A. Codd, executive vice-president, American Ordnance Association; George F. Reinhardt, Chief of Eastern European Affairs, Department of State; and Rear Adm. Albert G. Noble, Chief, Bureau of Ordnance, Navy Department.

• **AT BUFFALO ON MAY 25TH** the Empire Post held its annual meeting at the Hotel Statler. Maj. Gen. Everett S. Hughes, Chief of Ordnance, U. S. Army, was the principal speaker. Keith Williams was toastmaster, and the committee in charge was under the chairmanship of H. B. Sheets, vice-president of the Marine Trust Company, Buffalo. Other speakers were Lyman K. Stuart, chief, Rochester Ordnance District; Col. Harry L. Campbell, deputy chief of the

district; and Leo A. Codd, executive vice-president of the Association.

The various chapters of the Post also have been active. A spring dinner meeting of the Syracuse-Central New York Chapter was held March 31st at the University Club, Syracuse, N. Y. Speaker: Maj. Gen. Frederick M. Hopkins, chief of the Air Force's Industrial Mobilization Division. General Hopkins emphasized the importance of planning for industrial mobilization. DeAlton J. Ridings, president of Porter Cable Company, Syracuse, chairman of the chapter, presided.

• **MAY 27TH THE NEW YORK POST** attended a momentous meeting at Mitchel Air Force Base devoted to addresses by Air Force authorities and demonstrations and exhibits of Air Force matériel. More than 800 members and guests were present, nearly 300 of whom made the journey from New York City via the American Ordnance Special on the Long Island Railroad.

• **THE AMERICAN ORDNANCE ASSOCIATION** in an especial way, and American industry as well as the Nation generally, suffered two great losses by death in quick succession recently when Col. Frank A. Scott of Cleveland, Ohio, a founder of the Association in 1919, and Frank B. Bell, a stalwart member of the Ordnance fraternity, passed away. Their names thus united in death were closely associated to the very end. The Association's Gold Medal bearing the name of Colonel Scott was awarded to Mr. Bell just a few months ago. Both were citizens of unusual attainments whose patriotism and service to country were of heroic proportions.

Col. Frank A. Scott, one of the founders of the American Ordnance Association, died at his home in Cleveland, Ohio, April 15, 1949, at the age of seventy-six years. Few men have had more beneficent influence upon the national defense of the United States than had he. His death removes from the roster of civilian leaders the name of one who as a pioneer in the philosophy of industrial preparedness rendered outstanding service to the security of our country and the peace of the world in two World Wars and during the long armistice between.

Colonel Scott early in World War I was called upon by the Hon. Newton D. Baker, then Secretary of War, to organize the General Munitions Board for the allocation of available plant capacity to the growing needs for vital fighting equipment by our military and naval services. The General Munitions Board later became the War Industries Board of which Colonel Scott was Chairman until illness compelled him to forego further active participation in the first World War.

Later he became an adviser to the Army Industrial College and a regular annual lecturer there. For a time he served as chief of the Cleveland Ordnance District. Throughout all the years following World War I until his death he served as a director of the American Ordnance Association and gave unsparingly of his time and counsel to the direction of its affairs.

Frank Scott's first active participation in civic affairs was at the age of twenty-one when he became expert on foreign freight rates as a member of the staff of the Cleveland Chamber of Commerce. A great portion of his industrial career was devoted to the interests of the Warner & Swasey Company, designers and manufacturers of machine tools, and following World War I and until 1928 he was president of that company.

In the field of education, Colonel Scott was well-known for his service to Western Reserve University of which he was a trustee and to which he presented his famous library on the American Civil War.

Two of the many honors conferred upon him during his long and exemplary life were the award of the Distinguished Service Medal for his service in World War I and the foundation by the then Army Ordnance Association of the Frank A. Scott Gold Medal for distinguished service to the advancement of industrial preparedness. The Scott Medal during the past two decades has been presented to industrial leaders who have distinguished themselves for the excellence of their contributions to the advancement of industrial preparedness—a philosophy which Colonel Scott helped in a masterful way to develop.

Few men have influenced the American Ordnance Association during its long years of service to our national defense in greater degree than did Colonel Scott. Tireless in his loyalty and unfailing in his support, he helped guide the Association during its formative years and assisted in the maintenance of its high ideals of service throughout his long association with it.

In his passing away the American Ordnance Association records with sorrow its loss of a great and good friend who as soldier, industrialist, student of military affairs, and gentleman embodied the highest qualities of heart and soul for the advancement of his fellow men.

Frank Breckenridge Bell, founder and chairman of the board of the Edgewater Steel Company, and chief of the Pittsburgh Ordnance District during most of World War II, died May 6, 1949.

Born in Mercer, Pa., Mr. Bell attended the Mercer public schools and obtained his degree in mechanical engineering from Lehigh University in 1897. A few years later he became assistant open-hearth superintendent for the Clairton Steel Company and in 1905 moved to Melrose Park, Ill., where he was assistant superintendent of the Latrobe Steel & Coupler Company. In 1908 Mr. Bell left Latrobe Steel to build the Inter Ocean Steel Company plant at Chicago Heights, Ill., which later became part of the Railway Steel Spring Company, now a subsidiary of the American Locomotive Company.

Mr. Bell returned to Pittsburgh in 1916 and organized the Edgewater Steel Company. With the growth of that company, Mr. Bell came to be internationally recognized as one of the outstanding authorities on the design and manufacture of railway equipment and aided in building plants in England, Russia, India, Australia, and Japan.

Always active in the preparedness activities of the American Ordnance Association, Mr. Bell was named chief of the Pittsburgh Ordnance District in 1930 and, except for a year with the Office of Production Management and the War Production Board, served in that capacity until his death. In recognition of his services he had received the Award of Merit from the President of the United States and had been awarded the Frank A. Scott Gold Medal for distinguished Ordnance service.

Mr. Bell was a leader in community activities. During the depression he was cochairman of the Allegheny County Emergency Relief. He was an elder and member of the Shadyside Presbyterian Church and had been a member of General Council of the Presbyterian Church, U.S.A., and past president of the Pittsburgh-Lehigh Club and the Lehigh Alumni Association. He was a member of the Iron & Steel Institute, numerous technical societies, Duquesne, Longue Vue, Oakmont, and University Clubs.

At the time of his death Mr. Bell was a director of the Falk Foundation, the Fidelity Trust Company, and St. Barnabas Home. He was also a member of the advisory board of the Protestant Home for Incurables.

Of Frank Bell it can be said that his great loyalty to the national defense was surpassed only by his modesty of manner and his shunning of all personal aggrandizement. This magazine only two issues ago published his picture on its front cover and in a leading article tried to pay some slight tribute to him for his preeminent service to God and to Country.

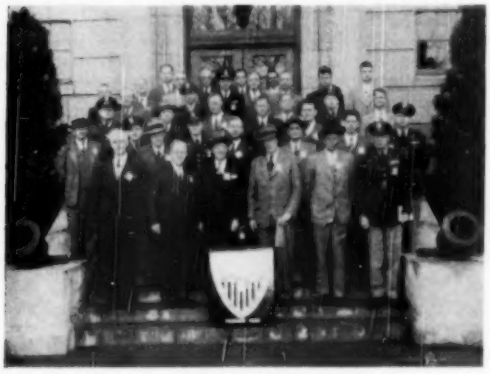
In the passing away of Frank Scott and Frank Bell the entire Ordnance fraternity grieves, for it has sustained a combined loss the weight of which would be crushing had not these great men inspired their associates to carry forward in the name of our national security and peace.—L.A.C.

The National Divisions, A.O.A.

Important Meetings Held Recently by Technical Groups

FIRE CONTROL INSTRUMENT DIVISION
Stanley C. Hope, chairman

The Mechanical, Optical, and Electronics Committees of the Fire Control Instrument Division of the A.O.A. gathered at Frankford Arsenal recently in one of the largest meetings of this group to date. The Frankford meeting served both as an orientation session for the Division on problems of fire control instrument design and manufacture and as a means of considering



Members of the Mechanical, Optical, and Electronics Committees at Frankford Arsenal.

production problems related to a new Ordnance instrument which soon will be manufactured.

About twenty-five committee members attended the meeting which was sponsored by Col. Ward E. Becker, commanding officer of the arsenal. A number of interesting exhibits illustrating the latest techniques in fire control instrument design were studied by the committee members before and during the meeting.

After Colonel Becker welcomed the group to the arsenal, Stanley C. Hope, chairman of the Fire Control Instrument Division and executive vice-president of Esso Standard Oil Company, outlined the purpose of the meeting. Mr. Hope asked the committee members to consider themselves a task group operating as consultants to the Ordnance Department on production problems. He urged the members to use their wide manufacturing experience in anticipating and overcoming problems which may be encountered in preparing new fire-control equipment for mass production.

The morning session was devoted to a presentation by engineers of the Fire Control Division of the arsenal of postwar developments in fire control for antiaircraft, field artillery, and fighting vehicles. In the afternoon specific problems in design as related to production were considered in discussions led by arsenal engineers. Detailed information on a new instrument was presented to the A.O.A. Fire Control Instrument Division members with the request that suggestions and recommendations on any changes which might improve manufacturing characteristics be submitted after study. The group is planning to report to Frankford Arsenal through the committee chairmen on this problem after examination of the material.

Colonel Becker was complimented by the Fire Control Instrument Division members on the excellent planning of the meeting and on the choice and splendid presentation of exhibits which added greatly to the interest of the session.

ROCKET, BOMB, AND ARTILLERY AMMUNITION DIVISION
Harvey C. Knowles, chairman

K. T. Norris, chairman of the Cartridge Case Committee of this Division, recently appointed a subcommittee with H. M. Heckathorn, Mullins Manufacturing Corporation, as chairman to consider the most satisfactory methods of manufacturing the 57-mm. recoilless steel cartridge case using multiple parts. This subcommittee met on March 23, 1949, at the Cleveland Hotel, Cleveland, Ohio, with eight industry members present, together with representatives of the armed services. The various possible ways of manufacturing the steel case were discussed and embodied in a detailed report.

The chairman requested those members of the Cartridge Case committee who were in Los Angeles on April 28, 1949, the day following the Thirty-first Annual Meeting of the American Ordnance Association, to meet with him informally at his plant —the Norris Stamping & Manufacturing Company. Several of the industry members of the committee, together with representatives of the armed services, attended this meeting.

GAGE INDUSTRY DIVISION
Louis Polk, chairman

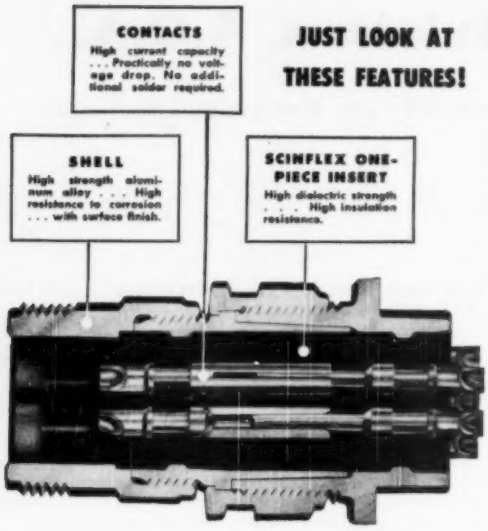
On April 8, 1949, the executive committee of this Division held a one-day meeting at the Wright-Patterson Air Force Base, Dayton, Ohio, with Chairman Louis Polk, president, Sheffield Corporation, presiding.

After a splendid address of welcome by the Commanding Gen-

Members of the Gage Industry Division Executive Committee (left to right): Col. W. E. Becker, Burton O. Lewis, Louis Polk, Capt. A. D. Blackledge, H. B. Hambleton, S. E. Reimel.

eral of the Air Matériel Command, USAF, the committee proceeded with their business session which lasted until noon.

During the afternoon the committee visited the technical laboratories of the air base and also witnessed a number of very interesting flights of latest-type planes.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The Reserves

FRANKFORD ACTIVATION

On April 4th, at a successful ceremony held at Frankford Arsenal, Philadelphia, Pa., the 2137th Frankford Arsenal Training Group of the Organized Reserve was officially activated—a significant and progressive step forward in Reserve affairs.

This training group, the first of its kind in the Nation, disproves the illogical idea that it would be necessary to transfer Reserve officers from all over the country to supplement the operating staff at an arsenal in event of a national emergency. Local officers, with homes permanently established in an arsenal's vicinity and thoroughly trained in its varied operations, are the logical personnel to carry on the mission of stepped-up wartime production.

The patriotism and spirit of the Frankford Arsenal group should stand as a model to the Organized Reserve Corps. For more than a year, while fighting for official recognition, these officers have been carrying on their Reserve activity without help. Their intelligent planning and solution of a problem that could have hampered production for war is a proofmark of their stature as sincere, constructive Americans.

OFFICER CALL HALTED

The Army has announced that civilian-component officers, other than those for whom orders have already been issued, will no longer be called to duty under Section 7 of the Selective Service Act. This section of the Selective Service Act provides that civilian-component officers with less than ninety days' active service may be called to active duty for twenty-one months. It was stated that, in view of the reduction in the planned strength of the Army, it is no longer necessary to implement Section 7 of the Selective Service Act as a means of procuring officers for extended active duty.

RULE ON RETIREMENT BENEFITS

The Office of the Comptroller General recently agreed that any member of a Reserve component of the armed forces with twenty years of satisfactory service is entitled to retirement benefits under Public Law 810 when he becomes sixty years old regardless of his status then. Previously the Comptroller General's Office had ruled that if such a member was separated from his component before he was sixty he was not entitled to these benefits. This ruling was based on two provisions of the law (sections 301(b) and 308), which were construed as showing intent of Congress that Reserve personnel had to be in active or inactive status to be eligible for retirement benefits.

RETIREMENT CREDITS

Provisions whereby Army Medical Department Reserve officers may earn enough retirement-credit points to constitute a year of Federal service according to Public Law 810, Title III, have been announced in Special Regulations 140-66-1, Department of the Army, dated December 28, 1948. The policies of the Chief, Army Field Forces, governing authorization of services to count for retirement-point credits . . . were announced as follows:

"The services for which retirement-point credits are awarded shall:

"a. Be performed in the individual's capacity as a Reserve officer or enlisted person. *(Continued on p. 58)*

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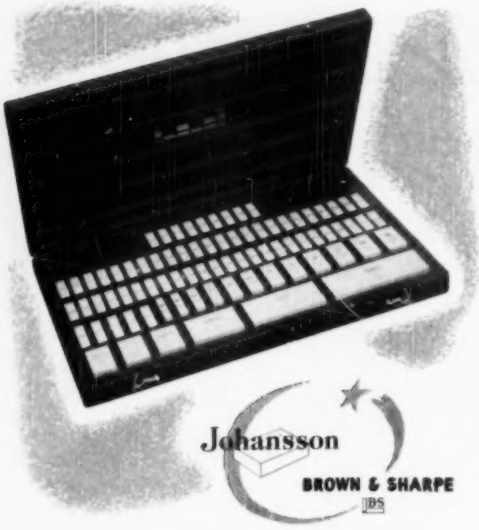

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"d. Require outlay of the individual's own time and effort beyond that required in the normal course of his civilian occupation.

"e. Be performed without remuneration of any kind other than U. S. Government pay as a member of the Army of the United States.

"f. Be supervised or previously approved by a unit instructor, ORC, or by higher authority; be of such nature that they are susceptible of verification; and be certified by the appropriate instructor, ORC, as having been performed."

RECRUITS WANTED

The Secretary of the Army recently called attention to the dwindling strength of enlisted personnel in the Organized Reserve Corps, and asked the young men of the Nation to respond to a Department of the Army campaign to bring this strength of the Reserves more nearly in line with mobilization requirements. A total of more than half a million enlisted civilian soldiers are needed. Tangible benefits Reservists now get for their services include nondisability retirement pay at age sixty after twenty years of service; eligibility for inactive duty drill pay; opportunities for promotions and commissions; short tours of active duty; and the opportunity to attend Army schools. The main purpose of the recruiting campaign is to seek reenlistment of thousands of former servicemen whose 3-year terms of enlistment in the Reserve Corps have expired or soon will expire.

R.O.C. REGULATIONS CHANGED

Regulations governing eligibility for the new Naval Reserve officer-candidate program, which starts July 7th, have been modified to permit the enrollment of enlisted members of Electronic Warfare Companies and Platoons of the Volunteer Reserve (Class V-3).

Heretofore only those Reservists who were enrolled in, or affiliated with, a division or squadron of the Organized Reserve in an enlisted status (Classes O-1, V-1, O-2, and V-2) were eligible.

Candidates for R.O.C. training must also be draft exempt, by reason of having had prior military service or membership in the aforementioned types of Reserve units prior to June 24, 1948, when the Selective Service Act became law.

Because of a recent Selective Service order that induction of all men in any Reserve component be postponed, it is anticipated that more categories of Reservists may be declared eligible for R.O.C. training by the summer of 1950.

EXTENDED ACTIVE DUTY

Extended active duty for participation in the Regular Army competitive tour program is still available to Reserve officers, although the recall of officers to extended active duty for other purposes has virtually ceased. The Army said authorization will continue for the recall of selected officers, in appropriate grade, to compete on one-year tours for Regular Army commissions.

The majority of commissions granted under this program will be in the grade of second lieutenant, but some officers with at least three years' active Federal service in commissioned status after reaching twenty-one will be appointed first lieutenants. No one is eligible for the competitive tour who will reach his thirtieth birthday before the tour is scheduled to begin.

Coming tours will begin on July 15th and October 15th. Applications must be dated at least 75 days before the beginning of the tour.

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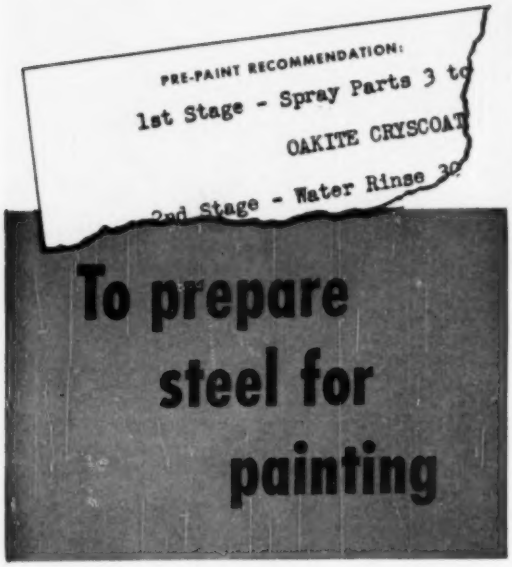
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Atomic Energy

NEW ATOMIC REACTORS

Four new kinds of nuclear reactors will be built under the auspices of U. S. Atomic Energy Commission in the near future. They are:

1. A reactor for testing materials for use in atomic machines. This high-energy, small-space reactor has been under design for two years at Oak Ridge National Laboratory.

2. A naval reactor to be constructed by Westinghouse. This will be a land-based prototype for a shipboard atomic power plant. Plans are being developed at Argonne National Laboratory near Chicago, and construction will be started in about a year.

3. A high-energy experimental breeder or fast reactor being designed at the Argonne Laboratory. This will operate with high-energy atomic bullets, or neutrons, like the present Los Alamos pile, but will be more powerful and use uranium 235 instead of plutonium for fuel.

4. An "in-between" reactor operating with neutrons at intermediate energies, between the slow neutrons of the wartime piles and the high-energy pile at Los Alamos. The intermediate reactor will be built at Knolls Atomic Power Laboratory operated by General Electric at Schenectady, N. Y.

Four other new kinds of atomic-energy machines are under study. They are:

1. A nuclear reactor for aircraft being investigated in a project called NEPA (nuclear energy for propulsion of aircraft). A survey of this field by the Massachusetts Institute of Technology is now being studied by the Commission.

2. A power plant using natural uranium for fuel. The Hanford plutonium-making reactors use natural uranium, but harnessing this fuel for power production is a job for the future.

3. A homogeneous reactor in which the fuel and materials for cooling, moderating, and reflecting would all be mixed together instead of having fuel embedded in the other materials.

4. A simple, low-cost reactor for scientific research and training of new technical people in atomic energy.

ATOMIC POWERED SUBMARINES

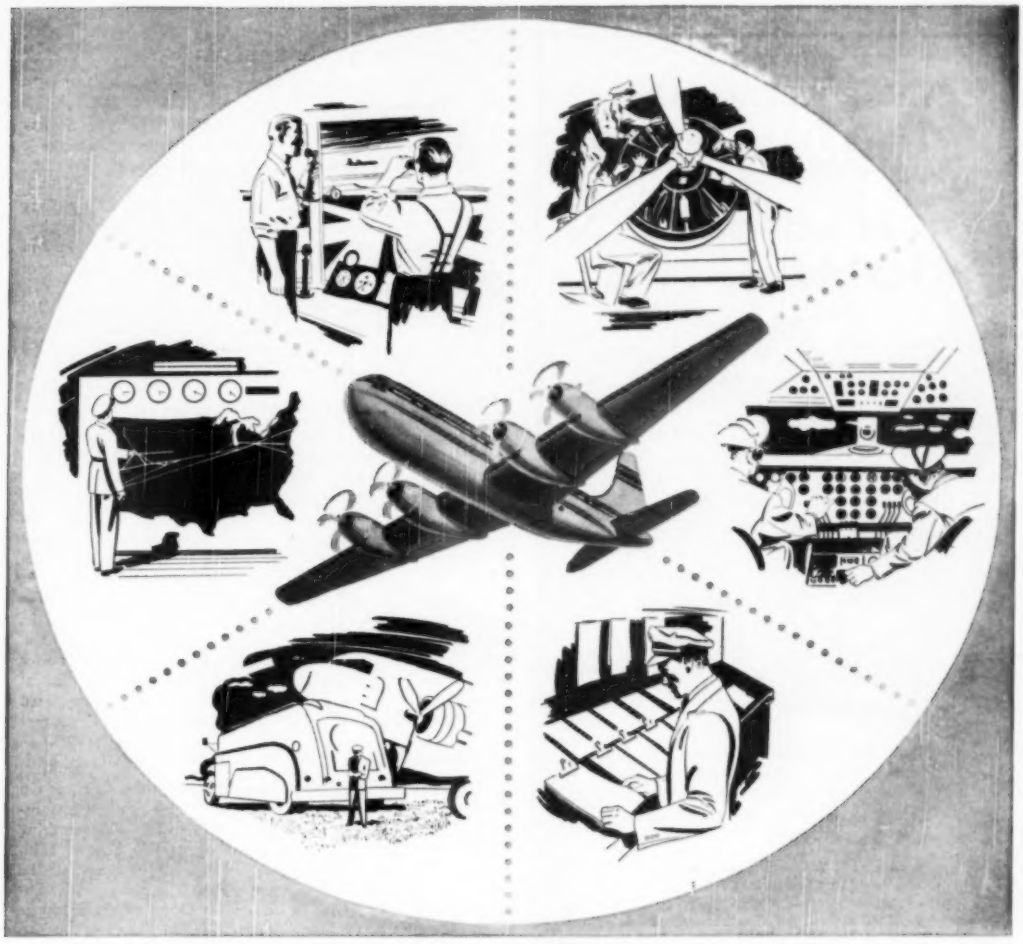
High-speed submarines powered by atomic engines emerged from the realm of speculation with the recent announcement that the Atomic Energy Commission and Westinghouse Electric Corporation have begun work on an experimental nuclear reactor to meet specifications for eventual use for ship propulsion.

Another indication of the increasing emphasis on submarine warfare came from Los Angeles, Calif., where Dr. Fritz Zwicky, director of research at the Aero-Jet Manufacturing Company, predicted that a new hydropulse engine, similar to turbo-jet aircraft engines, will enable submarines to travel at heretofore unknown speeds.

The first vessel most likely to be atomic powered would be a carrier, because the carrier has replaced the battleship as the "backbone" of the fleet. In addition, the Navy is most anxious to solve the problem now presented by smoke crossing the flight deck. Because of this smoke, carriers do not head directly into the wind while planes are landing.

Few if any details of the hydropulse engine were revealed by Dr. Zwicky, but he stated that it does away with propellers and uses water instead of air to mix with fuel in the combustion chambers.

(Continued on p. 62)



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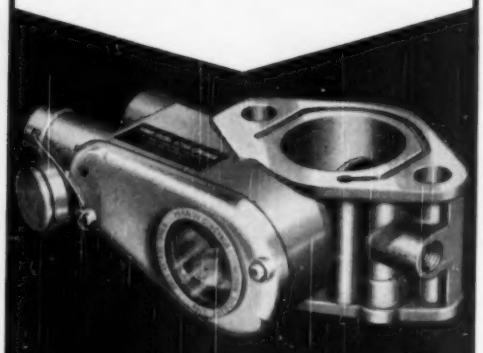

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SOVIET URANIUM DEPOSITS

According to a survey of Soviet uranium deposits just published, Russian efforts to build an atomic bomb may be concentrated in Central Asia in the Tashkent area. The Soviets have discovered enough uranium in the past decade to make it possible to develop atomic power in the future in Central Asia, the survey states.

No Soviet uranium deposits are known which are as rich as the two main sources of the element for American atomic work—the deposits in Canada and the Belgian Congo. Richest uranium ores known to be inside the U.S.S.R. are in Central Asia. There are also rich deposits of uranium in Czechoslovakia.

The Central Asiatic deposits are found within a radius of 250 miles from the important hydroelectric plants of the Tashkent area where water-power developments produced 882,000,000 kilowatt-hours of energy in 1943.

FUTURE ATOMIC PLANTS

Future atomic power plants are likely to be of two kinds, according to Richard G. Lorraine, of the General Electric Company's Central Station Engineering Divisions. He declared that one might expect large primary plants, producing great quantities of power as well as synthetic fuel. Such fuel could then be used in smaller secondary plants for the production of heat and power only. Some of these might be mobile units for propulsion power. At present there does not appear to be a feasible way of obtaining significant amounts of energy from an atomic reactor except in the form of heat. Consequently the reactor is, in effect, the firebox and combustion space of a boiler installation.

It is expected that one or two small-capacity atomic power plants will be in operation within three or four years, but at least twenty years and probably much more will be required before really large amounts of power are so generated.

RADIOACTIVE PISTON RINGS

Experiments with piston rings made radioactive in the uranium chain-reacting pile at the Oak Ridge National Laboratory forecast possible wide benefits to the American motoring public and operators of motorized equipment in general. With radioactive rings in an engine the amount of wear can be measured by an extremely simple method. In spite of the simplicity of the test, however, it is so delicate that as little as one-millionth of an ounce of metal worn from the rings can be detected. It is expected that in time the operators of motorized equipment will realize the benefits of these experiments in the form of lower repair and maintenance costs on the engine as a result of the use of improved fuels and lubricants.

URANIUM PROCESSING PLANT

The United States Atomic Energy Commission recently announced the signing of a contract with the U. S. Vanadium Corporation for the rehabilitation and operation of the corporation's uranium-vanadium processing plant at Uravan, Colo.

Under the terms of the contract, the U. S. Vanadium Corporation has agreed to rehabilitate the plant and the company-owned townsite and install new equipment and facilities for the recovery of uranium. The Commission has agreed to purchase the mineral production of the plant at a guaranteed unit price until June 30, 1954.

The purpose of the contract is to assure operation of the plant for the period covered by the Commission's Domestic Uranium Program Circular No. 5, which became effective February 1, 1949. The circular established a guaranteed minimum price for the uranium ores of the Colorado Plateau area until 1954.

The Uravan plant is expected to be ready for operation about the end of this year.

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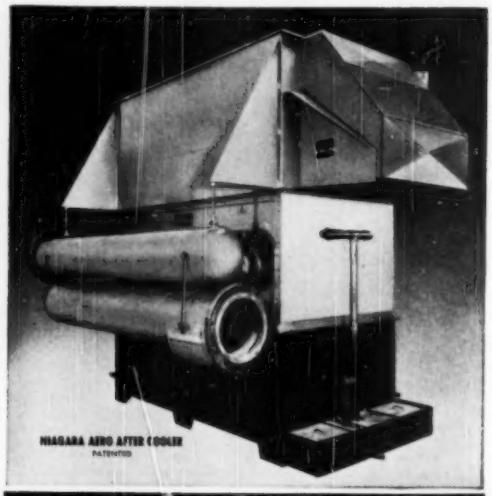

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Book Reviews

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COL. GEORGE S. BRADY, *consulting engineer, author, editor, Washington, D. C.*

F. W. FOSTER GLEASON, *military historian, ordnance analyst, editor, Washington, D. C.*

LIEUT. COL. CALVIN GODDARD, *small-arms authority, Tokyo, Japan.*

LIEUT. COL. MELVIN M. JOHNSON, JR., *automatic arms expert, inventor, author, New Haven, Conn.*

BRIG. GEN. R. H. SOMERS, *engineer, author, editor, Dover, N. H.*

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DR. JOHN J. O'CONNOR, *educator, author, editor, Washington, D. C.*

COL. PHILIP SCHWARTZ, *author, air ordnance expert, Headquarters, United States Air Force, Washington, D. C.*

Vision Ahead. By Air Commodore P. Huskinson, C.B.E., M.C. London: Werner Laurie. 198 pp. 11s. 6d. ($2.32).

FOR an ordnance book, "Vision Ahead" is easy to read. Written by an Armament (Ordnance) officer of the Royal Air Force who both designed and used aircraft weapons, it can be read without difficulty by the nontechnical reader. Although Air Commodore Huskinson was blinded during the German bombing of London in 1941, his strength of character was such that he continued to share in the responsibility for the development of aircraft weapons during the following four years.

The difficulties encountered by the RAF in obtaining improved aircraft weapons between the last two world wars are described in this book. Air Commodore Huskinson does not hesitate to express his opinion of the reasons for the lagging of the RAF weapons-development program between wars. He attributes it largely to red tape in the British Government and to the inability of British civil servants who, because they were unfamiliar with the use of aircraft armament, attempted unsuccessfully to evaluate the worth of funds requested for its development.

"Vision Ahead" is introduced with forewords by Lord Beaverbrook who describes it as "one of the outstanding stories of the war"; Marshal of the Royal Air Force Lord Tedder who calls it a "story of triumph over tragedy"; and by General of the Air Force H. H. Arnold who says "from this book can be gained a very good understanding of what must be avoided and what must be encouraged in future planning in the specialized field of air armament."

Every Ordnance officer of the armed forces and every Armament officer of the Air Force and others interested in the development of modern weapons should read this book. The armament developmental troubles of the RAF are often paralleled by those encountered by the U. S. Air Force. "Vision Ahead" should be in the library of institutions which have responsibility for the study of matters pertaining to research, design, development, or use of modern military weapons.

Air Commodore Huskinson was of considerable help to the Eighth Air Force while it operated in England and was awarded

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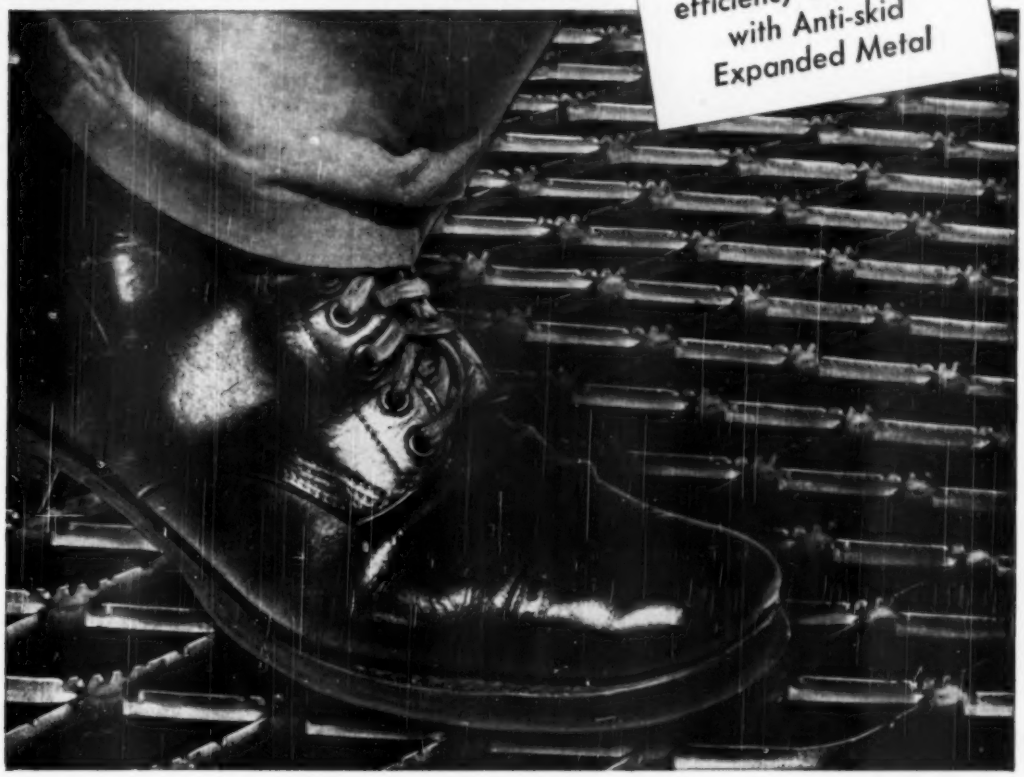

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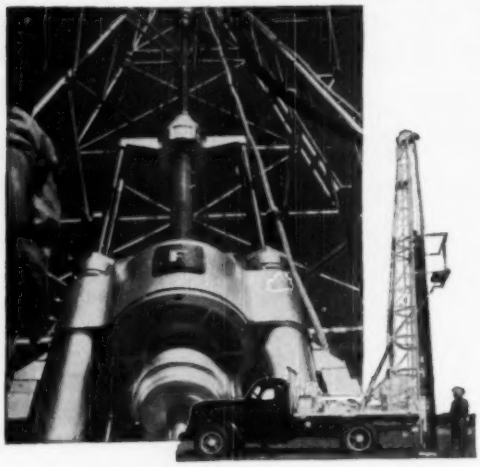

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Book Reviews

the Legion of Merit by General Arnold. His book does not neglect the contribution of the United States Air Force to the winning of the air war in Europe.—PHILIP SCHWARTZ.

Wartime Production Controls. By David Novick, Melvin L. Anshen, and William C. Truppner. New York: Columbia University Press. $6.

THE authors of this book have done a big job of analyzing the mass of background data on the controls used during the war. It should be a valuable reference for any one wishing to review what was done on materials control, scheduling, inventories, and use allocation. The authors also attempt to evaluate in terms of what might be done in a future emergency.

But, as with most economic books, there is the tendency to dwell on mechanized plans and overlook the human factors. The authors cite as an error of planning the fact that while the importation of rubber was doubled in 1940 no regulations were imposed to restrain consumption. It should be recalled that, until after Pearl Harbor, there was no legal authority for controls and no will to accept them. On page 197 the authors say that there is no answer to why the Controlled Materials Plan was a success when the Production Requirements Plan, equally good, had been a failure. Yet, on page 131, the real human reason appears self-evident when they say that officials had to fight so hard for the adoption of PRP that they had no time nor energy left to educate manufacturers regarding it.

The truth is that Americans do not like regimented economic planning and will take no interest in making it work unless they are convinced that the controls are necessary. By 1943, American manufacturers had sons, relatives, and neighbors in the fighting overseas, and some of their sons were being killed. They were ready to make any plan work that would help win the war. In reading the book the reader must supply for himself the human equation.—GEORGE S. BRADY.

Rocket Development: Liquid-Fuel Rocket Research, 1929-1941. By Robert H. Goddard. Edited by Esther C. Goddard and G. Edward Pendray. New York: Prentice-Hall, Inc. 291 pp. $6.50.

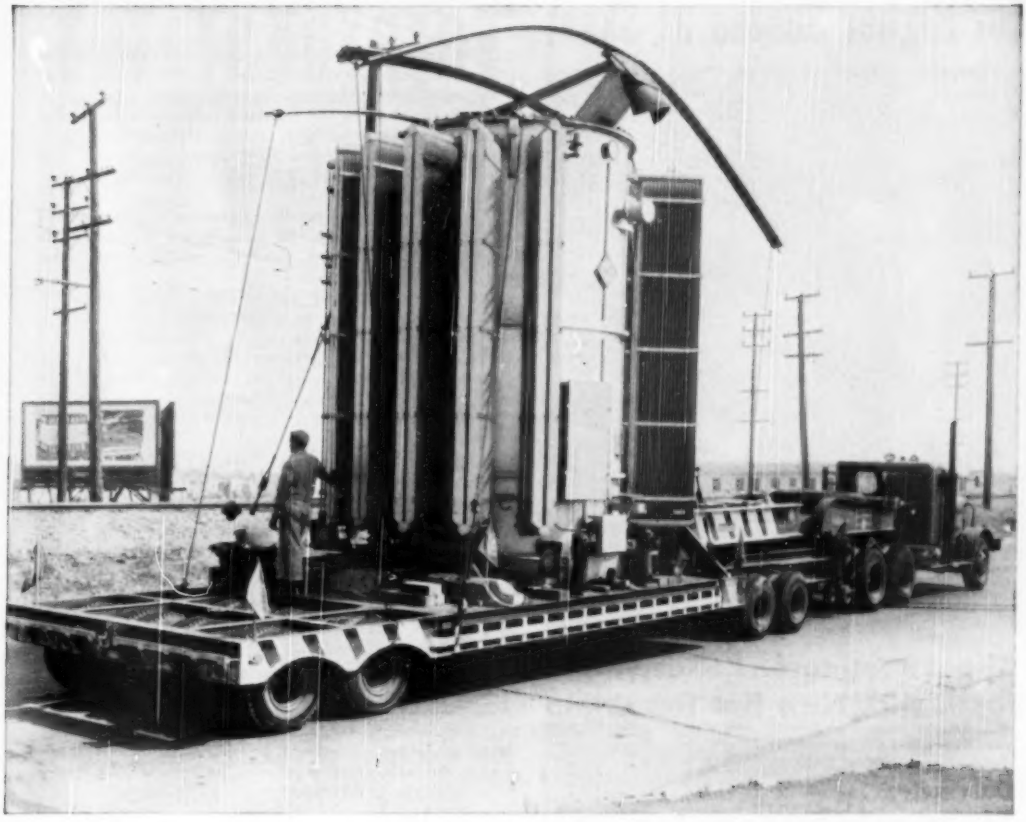
A FACTUAL account of the work of Dr. Goddard is a vital part of the story of modern rocket development. That it is edited by his wife and such an authority on rocket history as Pendray is a guarantee of understanding and accurate treatment.

Dr. Goddard's eminent work on rockets, prior to 1929, is here briefly summarized, but the body of the book is devoted to a very detailed account, in the form of summarized notes, of all his undertakings until the advent of World War II switched him to work (as yet confidential) for the Naval Engineering Experiment Station at Annapolis.

That the great mechanical detail of the account rules out much of interest to the general public is undoubtedly true, but this same element adds enormously to the volume's value to the student and the experimenter.—F. W. F. GLEASON.

Fear, War, and the Bomb. By P. M. S. Blackett. New York and Toronto: McGraw Hill Book Company. 244 pp. $3.50.

DR. BLACKETT is an outstanding British physicist; he won the Nobel prize in physics in 1948. During World War II he was scientific adviser to the British antiaircraft command and, later, director of naval operational research as it concerned campaigns against the U-boat. He evaluated weapons of the British sea and air forces as well as those of the Germans. He had a share in the British atomic-energy developments until 1948 when he returned to scientific research in the field of cosmic rays. A man with this background should be well qualified to write



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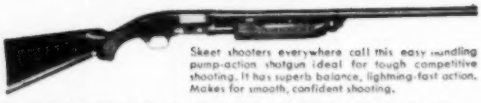

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Book Reviews

about the scientific and technical characteristics of atom bombs.

However, Professor Blackett attempts to evaluate all phases of the bomb, including its use for winning battles, convincing an enemy that he ought to quit fighting or not even begin, waging victorious war, and establishing permanent peace. To do so is no easy task, and he has made many of the mistakes which are to be expected when an effort is made to predict the effect of new weapons in a future war.

He expresses his opinion on the relative merits of atom bombs and so-called conventional bombs and on the value of strategic, as opposed to tactical, bombing. His list of references and quotations is formidable.

Many who read his book will not agree with his evaluation of the atom bomb. Further, he appears to have taken the Russian side of the United Nations' arguments on international control of atomic energy. There is enough factual information in the book to make it a must for students of current military history and for armchair strategists who want the pro and con arguments on the use of atomic energy in war.—PHILIP SCHWARTZ.

Eleven Generals. By Fletcher Pratt. New York: William Sloane Associates. 355 pp. $5.

IT is indeed unfortunate that events and circumstances have made many of our past military leaders near-gods, thereby almost obscuring completely men of lesser rank who played, in many instances, infinitely greater and more significant rôles in crucial battles of our country. Men such as Nathaniel Greene, Jacob Brown, John Buford, George H. Thomas, and Omar Bradley, subordinate to public idols, literally directed the course of history by their thinking and their skill.

Fletcher Pratt has selected eleven such generals out of our military roster whose influence on tactics and warfare has been immeasurably significant but whose popular recognition has been long, long overdue. And, what is more, Pratt has the happy faculty of making a complex battle plan beautifully simple and clear to the layman merely by using one-syllable plain Anglo-Saxon language.—PETER FIELD.

Encyclopedia of World Timbers. By F. H. Titmus. New York: Philosophical Library. $4.75.

BEST part of this book appears to be the title, which is a misnomer. The book is offered as a review of the woods of the world, but only 185 different woods are described. Numerous unimportant woods of Australia and Asia that do not enter commercial markets are described in detail while many of the more than a hundred commercial woods of North America are not mentioned. Insignificant woods like the "raspberry jam" of Australia and "stoolwood" of East Africa are described, while the commercially important Paraná pine of Brazil and hundreds

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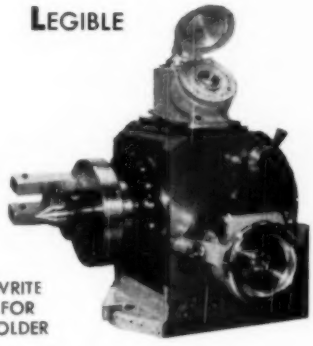

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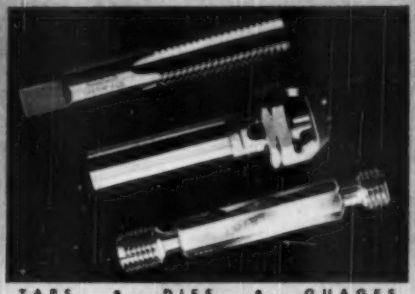

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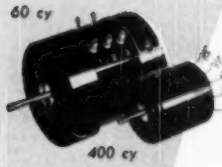

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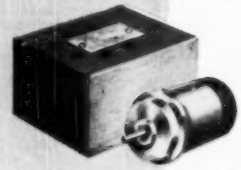

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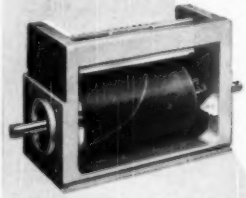

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of important hardwoods of Latin America are left out. Why the peach tree should be described as "timber," when important American timbers are omitted, is hard to gauge, unless one draws the conclusion that the book is merely a rehash of data the author happened to have without much research. This impression is strengthened by the fact that most of the sources quoted are secondary. —GEORGE S. BRADY.

Rifles: Volume II of the N.R.A. Book of Small Arms. By Walter H. B. Smith. Washington: National Rifle Association. Harrisburg: Military Service Publishing Company. 546 pp. $12.50.

PRESENTED as a companion volume to "Pistols and Revolvers" by the same author, "Rifles" differs quite radically from the earlier book, and the difference is not a happy one. The plan of classifying arms strictly by caliber has been abandoned, and all modern rifles are listed alphabetically by country as in Mr. Smith's "Small Arms of the World," from which much appears to be borrowed.

The book opens with seventy-five pages of rifle development and history. This is authoritative and fairly comprehensive though somewhat jumbled, and several key dates are missing or hazy. Types of actions are well covered in a short section.

Part III contains nearly 400 pages of description and illustration of modern rifles and cartridges. Again the pattern of "Small Arms of the World" is followed. Emphasis is placed on military rifles, and while some sporters are fully described and illustrated, most of them are treated in gun-catalogue form and not pictured. A fine glossary of rifle terms is of real potential value, and the book is rounded out by nine informative appendices.

However, one may well wonder if $12.50 for a single volume may not spread the idea that shooting is, after all, a rich man's sport!—F. W. FOSTER GLEASON.

The Empire and the Glory. By Fletcher Pratt. New York: William Sloane Associates. 535 pp. $3.75.

FLETCHER PRATT has the neat knack of being able to write about historical subjects in the present tense. What is more, he fills in the gaps between cold facts with the warmth of people, their personalities, and their emotions.

Here is another book to be added to the almost innumerable studies of Napoleon, this one dealing with the French period from 1800 to 1806, the years of Napoleon's efforts to entrench himself solidly as the First Consul of France.

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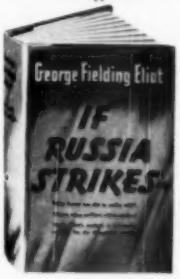

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career, it reveals that Bonaparte was, first of all, a great user of men; secondly, an opportunist; and, thirdly, a masterful and lucky general.

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Cartridges—A Pictorial Digest of Small-Arms Ammunition. By Herschel C. Logan. Huntington: Standard Publications, Inc. 199 pp. $5.

FEW LAYMEN, and not all students of ordnance, realize that in a very real sense the development of the cartridge is of greater significance than that of the arm. It is historically true that the entire development of the breech-loading small arm waited upon the advent of the metallic cartridge, and even today the characteristics of the load take a certain precedence over those of the arm. In spite of this, very few works on the general development of the cartridge have appeared.

This volume, by the author of "Hand Cannon to Automatic," is a reasonably complete and quite satisfactory answer to the need for such a volume. It is illustrated by the author with some six or seven hundred scale drawings of cartridges and their parts each accompanied by essential dimensions and a paragraph of description. Not of a technical character—ballistics data and exact performance are not attempted—it is nevertheless well calculated to give its readers a pretty thorough understanding of "gun fodder"—and a most enjoyable experience.

Both author and publisher are to be commended for their efforts, especially because they have refused to join the current stampede toward gun books which are priced out of reach.—F. W. F. GLEASON.

Blue Book of the American Gunsmiths Guild. Prepared by Frank Pierce and Roy S. Tinney. Natick: American Gunsmiths Guild.

THIS is a first edition of an annual to be compiled and published by the American Gunsmiths Guild, international headquarters of which are at Derryhoyle House, Natick, Mass. Prepared by Frank Pierce, president, and Roy S. Tinney, secretary, this little book represents a year of hard, consistent work. It lists the names and addresses of certain certified American gunsmiths. It is the hope of the publishers that succeeding issues will be enlarged and improved. Meanwhile, it can serve as a guide to all members of the small-arms fraternity when in search of gunsmiths and allied craftsmen who are entitled to use the Guild mark of quality.—L. A. COBB.

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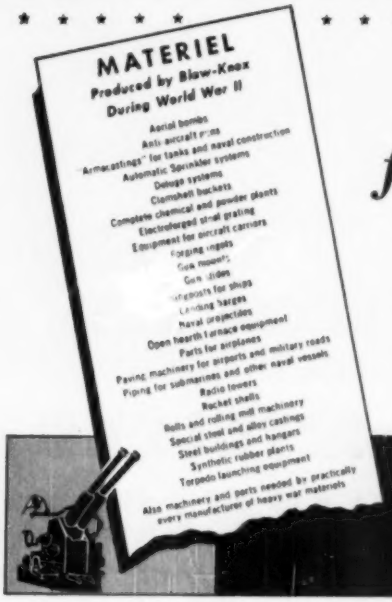

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[ORDNANCE—*composition, presswork, and binding—is the work of The William Byrd Press, Inc., Richmond, Va.*]

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The Index to Volume XXXIII of ORDNANCE, with title page for binding, is now available. It covers subjects in the following 1948 and 1949 issues: July-August (No. 169), September-October (No. 170), November-December (No. 171), January-February (No. 172), March-April (No. 173), and May-June (No. 174). It is arranged alphabetically by subject and author. Copies may be obtained free of charge, upon written request.

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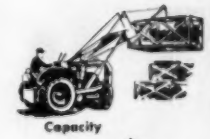
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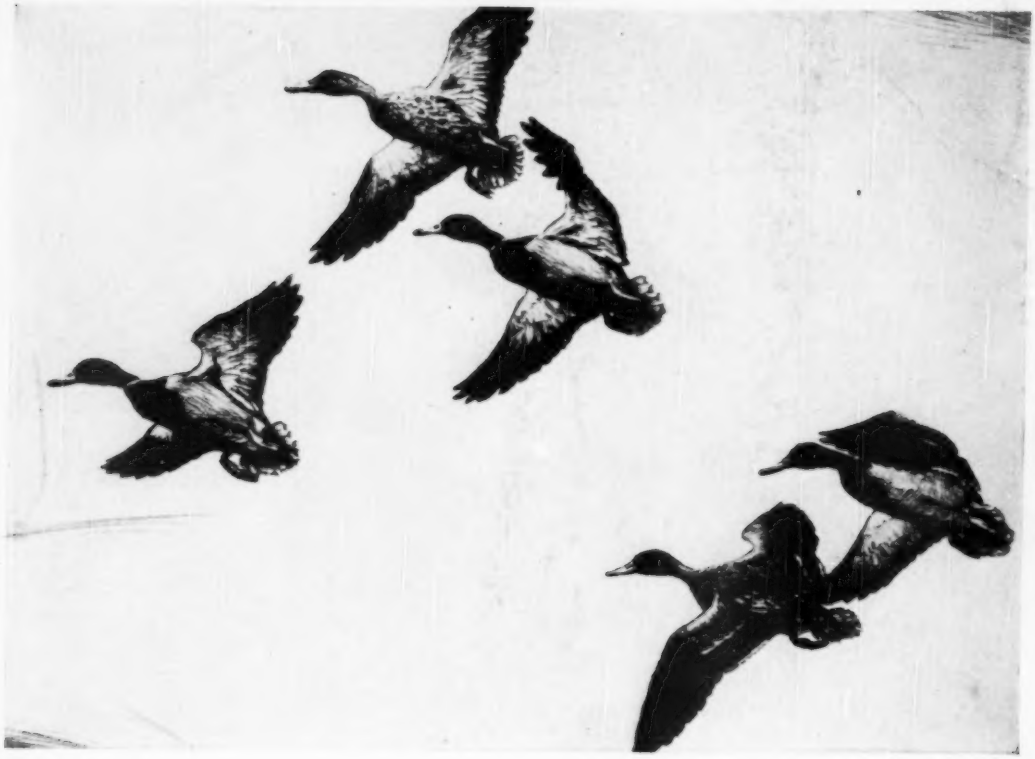

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by Hans Kleiber

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